IEC 61158-4-19

Edition 3.0 2014-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Industrial communication networks – Fieldbus specifications – Part 4-19: Data-link layer protocol specification – Type 19 elements

Réseaux de communication industriels – Spécifications des bus de terrain – Partie 4-19: Spécification du protocole de la couche liaison de données – Eléments de type 19

IEC 61158-4-19:2014-08(en-fr)

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX XH

ICS 25.040.40; 35.100.20; 35.110

ISBN 978-2-8322-1727-6

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INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 4-19: Data-link layer protocol specification – Type 19 elements

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NOTE Combinations of protocol types are specified in IEC 61784-1 and IEC 61784-2.

International Standard IEC 61158-4-19 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This third edition cancels and replaces the second edition published in 2010. This edition constitutes a technical revision. The main changes with respect to the previous edition are listed below:

- introducing connections based on a producer-consumer model;

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- introducing additional mechanisms to realize features such as timestamping and oversampling;
- improving the hotplug and redundancy features;
- improving the phase switching and the error handling;
- editorial improvements.

The text of this standard is based on the following documents:

FDIS	Report on voting
65C/762/FDIS	65C/772/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all the parts of the IEC 61158 series, under the general title *Industrial communication networks – Fieldbus specifications*, can be found on the IEC web site.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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- withdrawn,
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INTRODUCTION

This part of IEC 61158 is one of a series produced to facilitate the interconnection of automation system components. It is related to other standards in the set as defined by the "three-layer" fieldbus reference model described in IEC 61158-1.

The data-link protocol provides the data-link service by making use of the services available from the physical layer. The primary aim of this standard is to provide a set of rules for communication expressed in terms of the procedures to be carried out by peer data-link entities (DLEs) at the time of communication. These rules for communication are intended to provide a sound basis for development in order to serve a variety of purposes:

a) as a guide for implementors and designers;
b) for use in the testing and procurement of equipment;
c) as part of an agreement for the admittance of systems into the open systems environment;
d) as a refinement to the understanding of time-critical communications within OSI.

This standard is concerned, in particular, with the communication and interworking of sensors, effectors and other automation devices. By using this standard together with other standards positioned within the OSI or fieldbus reference models, otherwise incompatible systems may work together in any combination.

NOTE Attention is drawn to the fact that use of the associated protocol type(s) is restricted by its (their) intellectual-property-right holder(s). In all cases, the commitment to limited release of intellectual-property-rights made by the holder(s) of those rights permits a particular data-link layer protocol type to be used with physical layer and application layer protocols in Type combinations as specified explicitly in the profile parts. Use of the various protocol type(s) in other combinations may require permission from their respective intellectual-property-right holders.

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DE 102 00 502 4759.8-32	[BR]	Verfahren zur Laufzeitkorrektur in einer Kommunikationsstruktur
DE 102 37 097	[RI]	Korrektur von Signallaufzeiten in verteilten Kommunikationssystemen

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INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 4-19: Data-link layer protocol specification – Type 19 elements

1 Scope

1.1 General

The data-link layer provides basic time-critical messaging communications between devices in an automation environment.

This protocol provides communication opportunities to all participating data-link entities

a) in a synchronously-starting cyclic manner, according to a pre-established schedule, and
b) in a cyclic or acyclic asynchronous manner, as requested each cycle by each of those data-link entities.

Thus this protocol can be characterized as one which provides cyclic and acyclic access asynchronously but with a synchronous restart of each cycle.

1.2 Specifications

This standard specifies

a) procedures for the timely transfer of data and control information from one data-link user entity to a peer user entity, and among the data-link entities forming the distributed data-link service provider;
b) the structure of the fieldbus DLPDUs used for the transfer of data and control information by the protocol of this standard, and their representation as physical interface data units.

1.3 Procedures

The procedures are defined in terms of

a) the interactions between peer DL-entities (DLEs) through the exchange of fieldbus DLPDUs;
b) the interactions between a DL-service (DLS) provider and a DLS-user in the same system through the exchange of DLS primitives;
c) the interactions between a DLS-provider and a Ph-service provider in the same system through the exchange of Ph-service primitives.

1.4 Applicability

These procedures are applicable to instances of communication between systems which support time-critical communications services within the data-link layer of the OSI or fieldbus reference models, and which require the ability to interconnect in an open systems interconnection environment.

Profiles provide a simple multi-attribute means of summarizing an implementation’s capabilities, and thus its applicability to various time-critical communications needs.

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1.5 Conformance

This standard also specifies conformance requirements for systems implementing these procedures. This part of this standard does not contain tests to demonstrate compliance with such requirements.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE All parts of the IEC 61158 series, as well as IEC 61784-1 and IEC 61784-2 are maintained simultaneously. Cross-references to these documents within the text therefore refer to the editions as dated in this list of normative references.

IEC 61158-4-16:2007, *Industrial communication networks – Fieldbus specifications – Part 4-16: Data-link layer protocol specification – Type 16 elements*

ISO/IEC 7498-1, *Information technology – Open Systems Interconnection – Part 1: Basic Reference Model: The Basic Model*

ISO/IEC 7498-3, *Information technology – Open Systems Interconnection – Part 3: Basic Reference Model: Naming and addressing*

ISO/IEC 8802-3, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*

ISO 8601, *Data elements and interchange formats – Information interchange – Representation of dates and times*

IEEE 802.3: *IEEE Standard for Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications*

Internet Engineering Task Force (IETF), *Request for Comments (RFC): RFC 879, The TCP Maximum Segment Size and Related Topics* (available at <http://www.ietf.org/rfc/rfc0879.txt>)

3 Terms, definitions, symbols, acronyms, abbreviations and conventions

For the purposes of this document, the following terms, definitions, symbols, abbreviations and conventions apply.

3.1 Reference model terms and definitions

This standard is based in part on the concepts developed in ISO/IEC 7498-1 and ISO/IEC 7498-3, and makes use of the following terms defined therein.

3.2 Additional Type 19 terms and definitions

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3.2.1
broadcast
transmission to all devices in a network without any acknowledgment by the receivers

3.2.2
communication cycle
fixed time period between two master synchronization telegrams in which real-time telegrams are transmitted in the RT channel and non-real-time telegrams are transmitted in the IP channel

3.2.3
control unit
control device (for example, a PLC as specified in the IEC 61131 standard family)

3.2.4
control word
two adjacent octets inside the master data telegram containing commands for the addressed device

3.2.5
cross communication
direct multicast data transfer between devices

3.2.6
cycle time
duration of a communication cycle

3.2.7
cyclic communication
periodic exchange of telegrams

3.2.8
cyclic data
part of a telegram, which does not change its meaning during cyclic operation of the network

3.2.9
cyclic operation
operation in which devices in the communication network are addressed and queried one after the other at fixed, constant time intervals

3.2.10
device
a slave in the communication network, (for example, a power drive system as defined in the IEC 61800 standard family, I/O stations as defined in the IEC 61131 standard family)

3.2.11
device address field
address field (eight bits) containing the address of the device

3.2.12
device control
four adjacent octets inside the master data telegram containing commands for each device

3.2.13
device status
four adjacent octets inside the acknowledge telegram containing status information for each device

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3.2.14
DLE station identifier
network address assigned to a DLE

3.2.15
DLE station slot
unit (granularity of one) of position dependent mapping (for cyclic data field) of which a DLE may occupy one or more, delineated by the range beginning at the DLE station identifier with a length equal to the configured number of occupied slots

3.2.16
element
part of IDNs – each IDN has 7 elements, whereas each one has a specific meaning (for example: number, name, data)

3.2.17
EtherType
part of the Type 19 specific telegram header

3.2.18
forwarding
mode by which a device passes on a received telegram to the other port, either changed or unchanged

3.2.19
identification number
IDN
designation of operating data under which a data block is preserved with its attribute, name, unit, minimum and maximum input values, and the data

3.2.20
line
line structure
network topology, in which the transmission medium is routed from station to station in the form of a line; the information is transmitted in one direction from the master down to the last slave in the line, and then flows back to the master via all the slaves in the reverse order (CP16/3)

3.2.21
loopback
mode by which a device passes on a received telegram to the same port and to the other port, either changed or unchanged

3.2.22
master
node, which assigns the other nodes (i.e., slaves) the right to transmit

3.2.23
master data telegram
MDT
telegram, in which the master inserts its data

3.2.24
master DLE
DLE that performs the functions of network master

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3.2.25
master synchronization telegram
MST
telegram, or part of a telegram, in which the master inserts a time synchronization signal

3.2.26
MDT0 telegram
telegram, in which the master transmits its synchronization data, as well as parts or all of its real-time data, to the slaves

3.2.27
participant
node which is connected to the network

3.2.28
physical layer
first layer of the ISO-OSI reference model

3.2.29
protocol
convention about the data formats, time sequences, and error correction in the data exchange of communication systems

3.2.30
real-time data
part of the telegram that does not change its meaning during cyclic operation of the interface

3.2.31
RT channel
defined time slot within the communication cycle, which passes the CPF16 real-time telegrams

3.2.32
service channel
SVC
non real-time transmission of information upon master request during RT channel

3.2.33
slave
node, which is assigned the right to transmit by the master

3.2.34
slave DLE
DLE that performs the functions of network slave

3.2.35
station
node which is connected to the network

3.2.36
status word
two adjacent octets inside the acknowledge telegram containing status information of a device

3.2.37
S-0-nnnn
designation of IDNs

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3.2.38
telegram
DLPDU

3.2.39
topology
physical network architecture with respect to the connection between the stations of the communication system

3.2.40
topology index
position of a slave in a Type 19 network using a daisy chain numeration starting with value 1 at the first slave after the master

3.3 Symbols

ADR	device address (1 ≤ ADR ≤ 511) adjusted directly on the device, for example using a selector switch
AT MST	header in AT
AT0...3	acknowledge telegrams
INFO	service channel information
JtScyc	jitter in tScyc
MDT0	master data telegram with synchronization data that the slaves evaluates
MDT1...3	master data telegrams without synchronization data
P1	port 1
P2	port 2
RxD	received data
SLKN	slave identification parameter, slave arrangement
SVC	service channel
t1	AT transmission starting time
t1min	shortest AT transmission starting time
t3	command value valid time
t4	feedback acquisition capture point
t5	minimum feedback processing time
tcable	time, by which the transmitted signal is delayed by the cable, for each unit of length (approx., 5 ns/m)
trep	time, by which the received signal is delayed by a forwarding slave (input-output)

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tRing	time, which a master telegram needs, until it has passed through the network and reached the master again
tScyc	communication cycle time
TxD	transmitted data

3.4 Acronyms and abbreviations

AHS	service transport handshake of the device (acknowledge HS)
AT	acknowledge telegram
C-CON	connection control
C-DEV	device control
C1D	class 1 diagnostic
CP	communication phase
CPS	communication phase switching
CRC	cyclic redundancy check
CSoS	CIP Safety on SERCOS
FCS	DLPDU check sequence
FG	Function Group
FSP	Function-specific Profile
GDP	Generic Device Profile
HP	Hot-Plug
HP0	Hot-Plug phase 0
HP1	Hot-Plug phase 1
HP2	Hot-Plug phase 2
HS	service channel handshake (see AHS and MHS)
IDN	identification number
IP	Internet protocol
MAC	media access control
MDT	master data telegram
MDT MST	header in MDT

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MHS	service transport handshake of the master
MS	communication from slave to master
MST	master synchronization telegram
NRT	non real-time
P-channel	primary channel
P-telegram	primary telegram
PL	parametrization level
RT	real-time
RTC	real-time channel
RTD	real-time data in MDT or AT
S-DEV	device status
S-channel	secondary channel
S-telegram	secondary telegrama
SCH	session control header
SCP	Type 19 Communication Profile
SE	structure element
SERCOS	serial real-time communication system interface
SFD	start DLPDU delimiter
SI	structure instance
SMP	Type 19 Messaging Protocol
SVC	service channel
UCC	unified communication channel

3.5 Additional conventions

All data types are assigned identification numbers (IDNs). They include real-time data (commands and feedback values), parameters, and procedures. Most IDNs are similar to those for Type 16 (see IEC 61158-4-16, 3.6). Several IDNs relate to the application and are defined in their relevant standards (for example, IEC 61800-7-20x for Power Drive Systems).

Refer to Annex A for additional information, as well as to IEC 61158-4-16, Clause A.1 for detailed IDN specification.

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4 DL-protocol overview

4.1 Overview

This protocol type provides a highly optimized means of interchanging fixed-length real-time data and variable-length segmented messages between a single master device and a set of slave devices, interconnected in a ring or a line topology. The ring topology provides for redundant communication paths, and in case of a fault it automatically switches to a set of two lines without disturbing the communication.

This protocol type also provides for direct real-time data transmission between slaves, inside the real-time channel (RTC), within each communication cycle.

The exchange of real-time data is totally synchronous by configuration and is unaffected by the messaging traffic.

The device addresses are set by the user, using a selector for example. Additional devices may be added whenever required, even during operation, without affecting the address selections, which already exist. The determination of the number, identity and characteristics of each device may be configured or may be detected automatically at start-up.

Slave interfaces shall be used to connect the slave devices to the network. At the physical layer, a slave represents the connection of one or more devices to the network. Logically, one slave with several devices shall act the same as several slaves with one device each.

This protocol type also provides a unified communication channel (UC channel), in which any Standard Ethernet DLPDUs can be exchanged between Type 19 devices and any other connected Ethernet network nodes.

There are two classes of Type 19 DLE:

a) master DLE;
b) slave DLE.

Only the master DLE is able to initiate cyclic transmission.

Type 19 telegrams are Ethernet DLPDUs according to ISO/IEC 8802-3. Type 19 real-time telegrams shall be transmitted in the real-time part of the communication cycle time. They mainly transport input and output data, for example command and feedback values. The Type 19 header specifies two types type 19 telegrams:

a) Master data telegram (MDT), in which the master transmits real-time data to the slaves;
b) Acknowledge telegram (AT), in which the slaves transmit real-time data to the master and other slaves.

Other Ethernet DLPDUs can be transmitted in the UC channel.

Type 19 specifies 4 MDTs (MDT0 to MDT3). The MDTs shall be transmitted by the master and received by each slave. The MDTs shall contain all information (for example: synchronization, command values, digital outputs) which is sent from the master to the slaves through the real-time channel.

MDT0 shall always be transmitted. MDT1 through MDT3 shall be transmitted only if required depending on the configuration of the application data to be transmitted. The master shall always send the same number of MDTs during each communication cycle.

Type 19 specifies 4 ATs (AT0 to AT3). The ATs shall be transmitted by the master with the configured AT length. The AT data fields are set to 0, except the application data of cross

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communication. Each slave shall insert its data into its allocated data field within the AT. The ATs shall contain all information (for example: feedback values, digital inputs) which is sent from the slaves to the master as well as to other slave devices through the real-time channel.

AT0 shall always be transmitted. AT1 through AT3 shall be transmitted only if required depending on the configuration of the application data to be transmitted. The master shall always send the same number of ATs during each communication cycle.

The allocations of the service channels (SVC), the device control (C-DEV), the device status (S-DEV) and the connections in the MDT as well as in the AT shall be configured with parameters. The lengths of connections in the MDTs and the ATs shall depend on the amount of application data and may be different for each slave depending upon configuration. The number of MDTs and ATs may also be different because of the configuration. This configuration shall meet the following requirements.

a) A SVC of a slave shall be transmitted within one MDT or one AT and shall not be spread into different MDTs or ATs.
b) A connection of a slave shall be transmitted within one MDT or one AT and shall not be spread into two different MDTs or ATs.
c) Each connection and SVC shall start at an even address in the MDT and AT.
d) Each device control and device status shall start at an even address in the MDT and AT.
e) All other combination of configurations of SVCs, connections, device control and device status are possible.

Devices in a Type19 network use the order of little endian for the serial transmission of data. Little endian describes the least significant bit of the least significant octet of the least significant word is sent first, followed by the rest of the bits of this octet, then by the rest of the octets of this word, and so on in the same order.

4.2 General DLPDU identification

4.2.1 Introduction

DLPDUs shall be identified as specified in Table 1.

Table 1 – Ethernet DLPDU identification

DLPDU field	Data type	Value/description
Dest MAC	octet[6]	Destination MAC address
Src MAC	octet[6]	Source MAC address
EtherType	WORD	0x88CD (Type 19)

4.2.2 Destination address (Dest MAC)

The master shall transmit DLPDUs to all slaves using the broadcast address 0xFFFF FFFF FFFF as the destination address.

4.2.3 Source address (Src MAC)

The source address shall always be the MAC address of the master.

4.2.4 EtherType

The EtherType for real-time DLPDUs shall contain the value 0x88CD, which is the unique type field number that has been allocated by the IEEE EtherType Field Registration Authority for Type 19 telegrams.

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NOTE This field number refers to Type 19 communication.

4.3 General DLPDU structure

4.3.1 Introduction

The data structure in a DLPDU shall consist of the following data entries as specified in Table 2.

Table 2 – Data structure in a DLPDU

Data field	Data type	Value/description
Header	octet[6]	Defines the DLPDU type
Payload	octet[40-1494]	Data fields are padded, if less than 40 octets

4.3.2 DLPDU header

The DLPDU header shall specify two types of telegrams, as specified in 4.4:

- **Master data telegram (MDT):** MDTs shall transmit data from the master to the slaves;
- **Acknowledge telegram (AT):** ATs shall transmit data from the slaves to the master, as well as to other slaves within the Type 19 network.

4.3.3 DLPDU payload

All transmitted data are permitted to have arbitrary bit sequences.

Padding octets shall be added if the Type 19 data is less than 40 octets, in order to reach a total data field length of at least 46 octets.

The DLPDU payload shall be as described in 4.5 and 4.6.

4.4 DLPDU header

4.4.1 Introduction

The DLPDU header shall distinguish the various DLPDUs. It shall be coded in the telegram whether the DLPDU is transmitted in the primary or secondary channel, whether it is an MDT or an AT, and which one (MDT0 to MDT3, respectively AT0 to AT3).

In a line topology, the master shall decide whether the telegrams are marked as primary or secondary telegrams, depending upon configuration.

The DLPDU header structure is shown in Table 3:

Table 3 – DLPDU payload header

Data field	Data type	Value/description
DLPDU type	octet[1]	see 4.4.2
Reserved	octet[1]	—
Reserved	octet[4]	—

4.4.2 DLPDU type

The DLPDU type shall be generated by the master and transmitted in every MDT and AT. Its content shall be as shown in Table 4.

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Table 4 – DLPDU type

Bit number	Bit value	Description
7	—	Primary or secondary telegram
	0	Telegram on the primary channel (P-Telegram)
	1	Telegram on the secondary channel (S-Telegram)
6	—	MDT or AT
	0	MDT
	1	AT
5	—	Cycle CNT
	0	Cycle CNT is disabled
	1	Cycle CNT is enabled (Cycle CNT is defined in MDT phase (bit 6-4)
4	—	(reserved)
3-2		(reserved for Telegram number 4 to 15)
1-0	—	Telegram number
	00	Telegram number 0
	01	Telegram number 1
	10	Telegram number 2
	11	Telegram number 3

4.5 MDT DLPDU

4.5.1 MDT MST field summary

The MDT shall be as specified in Table 5. The MDT header of MDT0 is called MST.

Table 5 – MDT header

DLPDU part	Data field	Data type	Value/Description
MDT header	MDT type	octet[1]	see 4.5.3
	MDT phase	octet[1]	see 4.5.4
	MDT CRC	octet[4]	see 4.5.5

4.5.2 Evaluation of MDT header in the slaves

The MDT header shall be generated by the master and evaluated by the slaves. Each slave shall evaluate the MDT header according to Table 6.

Table 6 – MDT header to be considered by the slave

	MDT type	MDT phase	MDT CRC
MDT0 = MST	Yes	Yes	Yes
MDT1	Yes	No	Yes
MDT2	Yes	No	Yes
MDT3	Yes	No	Yes

NOTE The slave has to evaluate the MDT type and MDT phase only if the MDT CRC is valid.

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4.5.3 MDT type

Refer to 4.4.2, whereas bit #6 shall be 0.

4.5.4 MDT phase

The MDT phase shall contain the status of the Type 19 communication during initialization and during CP4. The phase shall be generated by the master and transmitted in every MDT. The structure is shown in Table 7.

Table 7 – MDT phase

Bit number	Bit value	Description
7	—	Communication phase switching (CPS)
	0	Current CP Communication phase (bit 3-0) contains current CP.
	1	New CP Communication phase (bit 3-0) contains the target CP for phase switching.
6-4	—	Cycle CNT (shall be enabled in MDT DLPDU type, bit 5 is set to 1)
	0-7	Value of Cycle CNT (is incremented by 1 in each communication cycle by the master)
3-0	—	Communication phase (CP)
	0000	CP0
	0001	CP1
	0010	CP2
	0011	CP3
	0100	CP4
	0101 to 1111	(reserved)

4.5.5 MDT CRC

The cyclic redundancy check (CRC) shall be used by the transmit and receive algorithms to generate a CRC value for the MDT CRC field. The MDT CRC field shall contain a 4-octet (32-bit) cyclic redundancy check (CRC) value. This value shall be computed as a function of the contents of the destination address (see 4.2.2), source address (see 4.2.3), EtherType (see 4.2.4), Type 19 type (see 4.4.2) and phase (see 4.5.4). The encoding shall be as defined by the Standard Ethernet CRC generating polynomial (see ISO/IEC 8802-3).

The MDT CRC shall be generated by the master and transmitted in every MDT (MDT0 to MDT3). This CRC shall be evaluated in every MDT by the slave (see Table 6).

4.5.6 MDT payload during initialization

4.5.6.1 General

The content of the MDT data field depends on the communication phase (CP) and is described in the following subclauses.

4.5.6.2 CP0

The master shall always transmit MDT0 telegrams only, and no MDT1, MDT2, nor MDT3 telegrams. MDT0 shall be structured as stated in Table 8.

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Table 8 – MDT0 structure in CP0

DLPDU part	Data field	Data type	Value/Description
MDT	MDT type	octet[1]	MDT0, see 4.5.3
	MDT phase	octet[1]	CP0, see 4.5.4
	MDT CRC	octet[4]	see 4.5.5
MDT payload	Communication version	octet[4]	see Table 9
	MDT Data Field	octet[36]	Shall be padded and not used

Table 9 – Communication version

Bit number	Bit value	Description
31-23	—	(reserved: 0x00 as valid combination shall be checked by slaves)
22	—	SWC
	0	Non-Type 19 (Industrial Ethernet) devices not used by application
	1	Non-Type 19 (Industrial Ethernet) devices used by application: last slave in line shall not forward Type 19 telegrams to the inactive port (loopback without forward shall be activated), only last slave shall set S-0-1032 Communication control.bit 3 = 1
21	—	Fast CP switch
	0	Transmission of MST (MDT0) interrupted during CP switch for CPS delay time (120ms)
	1	CPS delay time reduced to the reconfiguration time of the master (shall be acknowledged by the slave in the topology index field of AT0-CP0)
20	—	Transmission of communication parameters in MDT0 of CP0
	0	No transmission of parameters
	1	Transmission of the following parameters: - AT0 transmission starting time (t1-CP1&CP2) - Beginning of UC channel (t6-CP1&CP2) - End of UC channel (t7-CP1&CP2)
19-18	—	(reserved: 0x00 as valid combination shall be checked by slaves)
17-16	—	Structure and number of MDTs and ATs in CP1 and CP2
	00	2 MDTs and 2 ATs in CP1 and CP2 (include SVCs, C-DEV, S-DEV) – up to 255 slaves
	01	4 MDTs and 4 ATs in CP1 and CP2 (include SVCs, C-DEV, S-DEV) – up to 511 slaves
	10	(reserved)
	11	(reserved)
15-8	—	(reserved)
7-1	—	(reserved: 0x00 as valid combination shall be checked by slaves)
0	—	Address allocation
	0	Without address allocation (used for Type 19 Version 1.0 only)

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Bit number	Bit value	Description
	1	Address allocation (shall be used for Type 19 Version 1.1.1 and greater)

4.5.6.3 CP1 and CP2

The master shall choose between two communication sequences used in CP1 and CP2:

a) If the master supports 255 slaves or less, it may transmit either MDT0 to MDT3 or MDT0 and MDT1 only, for example to save initialization time.
b) If the master supports 256 slaves or more (up to 511 slaves) it shall transmit MDT0 to MDT3.

The slaves shall support both sequence options. It shall select the required one by evaluating bit 17 and bit 16 of the communication version (see Table 9).

The MDT data fields shall contain the service channel (see 6.2) and the device control (see 4.5.7.4.2) of the topology indices as shown in Table 10, Table 11, Table 12 and Table 13 respectively.

In CP1 a slave shall behave as requested if the handshake bit (MHS) is set to 1 in the corresponding SVC control. The MDT SVC INFO is “don’t care”. The content of device control shall be valid.

Telegrams in CP2 shall have the same structure as in CP1, but the contents of SVC INFO shall be valid only in CP2.

Table 10 – MDT0 in CP1 and CP2 (topology indices 0 to 127)

DLPDU part	Data field	Data type	Value/Description
MDT MST	MDT type	octet[1]	MDT0, see 4.5.3
	MDT phase	octet[1]	CP1 or CP2, see 4.5.4
	MDT CRC	octet[4]	see 4.5.5
MDT data field	MDT SVC for topology index #0	octet[6]	—
	…	…	(And so on for topology indices #1 to #126)
	MDT SVC for topology index #127	octet[6]	—
	Device control for topology address #0	octet[2]	—
	Reserved for topology index #0	octet[2]	—
	…	…	(And so on for topology indices #1 to #126)
	Device control for topology index #127	octet[2]	—
	Reserved for topology index #127	octet[2]	—

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Table 11 – MDT1 in CP1 and CP2 (topology indices 128 to 255)

DLPDU part	Data field	Data type	Value/Description
MDT MST	MDT type	octet[1]	MDT1, see 4.5.3
	MDT phase	octet[1]	CP1 or CP2, see 4.5.4
	MDT CRC	octet[4]	see 4.5.5
MDT data field	SVC of topology index #128	octet[6]	—
	…	…	(And so on for topology index #129 to #254)
	SVC of topology index #255	octet[6]	—
	Device control of topology index #128	octet[2]	—
	Reserved for topology index #128	octet[2]	—
	…	…	(And so on for topology index #129 to #254)
	Device control of topology index #255	octet[2]	—
	Reserved for topology index #255	octet[2]	—

Table 12 – MDT2 in CP1 and CP2 (topology indices 256 to 383)

DLPDU part	Data field	Data type	Value/Description
MDT MST	MDT type	octet[1]	MDT2, see 4.5.3
	MDT phase	octet[1]	CP1 or CP2, see 4.5.4
	MDT CRC	octet[4]	see 4.5.5
MDT data field	SVC of topology index #256	octet[6]	—
	…	…	(And so on for topology index #257 to #382)
	SVC of topology index #383	octet[6]	—
	Device control of topology index #256	octet[2]	—
	Reserved for topology index #256	octet[2]	—
	…	…	(And so on for topology index #257 to #382)
	Device control of topology index #383	octet[2]	—
	Reserved for topology index #383	octet[2]	—

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Table 13 – MDT3 in CP1 and CP2 (topology indices 384 to 511)

DLPDU part	Data field	Data type	Value/Description
MDT MST	MDT type	octet[1]	MDT3, see 4.5.3
	MDT phase	octet[1]	CP1 or CP2, see 4.5.4
	MDT CRC	octet[4]	see 4.5.5
MDT data field	SVC of topology index #384	octet[6]	—
	…	…	(And so on for topology index #385 to #510)
	SVC of topology index #511	octet[6]	—
	Device control of topology index #384	octet[2]	—
	Reserved for topology index #384	octet[2]	—
	…	…	(And so on for topology index #385 to #510)
	Device control of topology index #511	octet[2]	—
	Reserved for topology index #511	octet[2]	—

4.5.6.4 CP3 and CP4

In CP3 and CP4, the master shall transmit MDTs with the same structure (see 4.5.7).

In CP3, only the service channel and the device control shall be valid. The configured application data in the connections of the MDTs shall not be evaluated, but they shall have the number of octets required for CP4. The positions of the service channels and the connections in the MDT relevant to the individual slaves shall be as transmitted by the master to the slaves during CP2 with the corresponding communication parameters.

In CP4, the configured application data shall be valid and filled with command values as determined by the parameters that the master transmitted to the slaves during CP2. The connection control and the resource control which depend on the application profile shall be valid.

4.5.7 MDT payload in normal operation

4.5.7.1 Introduction

The MDT payload of MDT0 (see Table 14) shall always contain

a) one MDT0 hot-plug field (see 4.5.7.2) and depending on the configuration;
b) one MDT0 extended field;
c) several service channels, one per slave only (see 5.5.7.2.4);
d) several device controls, one per slave only;
e) several connections (see 4.5.7.4).

The MDT payload of MDT1 to MDT3 (see Table 14) can contain depending on the configuration

a) several service channels, one per slave only (see 5.5.7.2.4);
b) several device controls, one per slave only;
c) several connections (see 4.5.7.4).

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Table 14 – MDT data field

DLPDU part	Data field	Data type	Value/Description
MDT data field	MDT0 hot-plug field	octet[8]	In MDT0 only, see 4.5.7.2
	MDT0 extended field	octet[4]	In MDT0 only, see 4.5.7.2
	MDT service channels	octet[see 4.5.7.3]	Optional. see 4.5.7.3
	MDT real-time data	octet[see 4.5.7.4]	Optional. see 4.5.7.4

For each slave,

- IDN S-0-1013 (SVC offset in MDT) shall set the offset for its service channel;
- IDN S-0-1009 (Device Control offset in MDT) shall set the offset for the device control;
- IDN S-0-1050.x.3 (Telegram assignment) shall set the offset for the connection data;
- IDN S-0-1050.x.5 (Current length of connection) shall contain the length of the connection data;
- IDN S-0-1010 (Lengths of MDTs) shall contain the lengths of all MDTs (in Figure 1 shown for MDT0 only).

These parameters shall be transmitted by the master to the slaves in CP2.

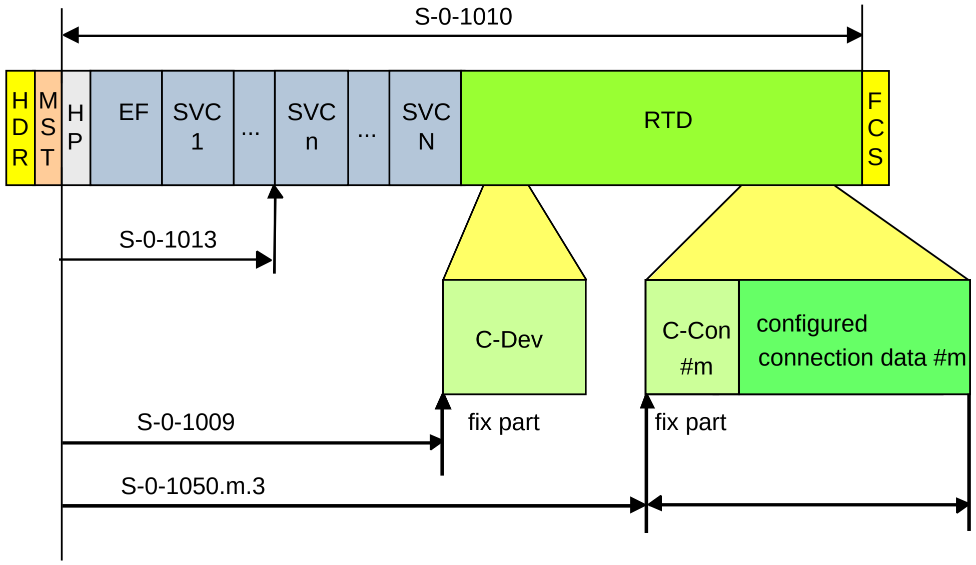

Figure 1 – Example of offsets within MDT payload

4.5.7.2 MDT hot-plug field

4.5.7.2.1 MDT hot-plug field summary

The structure of the MDT hot-plug field shall be as specified in Table 15, depending upon hot-plug phases (see 5.5).

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Table 15 – MDT hot-plug field

DLPDU part	Data field	Data type	Value/Description
MDT hot-plug field	MDT-HP address	octet[2]	see 4.5.7.2.2
	HP control	octet[2]	see 4.5.7.2.3
	MDT-HP INFO	octet[4]	see 4.5.7.2.4

4.5.7.2.2 MDT-HP address field

The content of the HP address field in the MDT shall be as specified in Table 16:

Table 16 – HP address in MDT-HP field

Bit number	Value	Description
15-12	—	Slave index specifies the number of slaves within one device (device can contain multiple slaves)
	0-15	Slave index (set by master in HP0)
11-0	—	Device addresses
	0-511	Device addresses for operation (set by master in HP1 and HP2)
	512-4092	(reserved)
	4093	(reserved)
	4094	(reserved)
	4095	Broadcast address (set by master in HP0, each HP slave shall react to this address)

4.5.7.2.3 HP control field (in HP0 and HP1)

The content of HP control field shall be as specified in Table 17.

Table 17 – HP control field (in HP0 and HP1)

Bit number	Value	Description
15	—	Hot-Plug support (the master shall set this bit to 1 in CP4, if hot-plug is supported)
	0	Hot-Plug not supported by master (slave shall switch from HP0, HP1 or HP2 to NRT mode)
	1	Hot-Plug supported by master (HP slave prepared HP function)
14-10	—	(reserved)
9	—	Enable / disable Hot-plug
	0	Hot-Plug disabled (HP slave shall switch to HP0)
	1	Hot-Plug enabled (HP slave shall evaluate the HP field)
8	—	HP field vs. SVC communication
	0	HP field is used only (the master uses only the HP field to communicate with the HP slave)
	1	HP field and SVC are used (the master uses the HP field and the SVC to communicate with the HP slave)
7-0	—	Coding of HP0 parameters (0 to 127)
	0	No HP parameter (MDT-HP INFO is don't care)
	1	Communication cycle time (tScyc, S-0-1002)

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Bit number	Value	Description
	2	Beginning of UC channel (t6, S-0-1017, list element 0)
	3	End of UC channel (t7, S-0-1017, list element 1)
	4	Requested MTU (S-0-1027.0.1)
	5	Communication version (content in MDT0 of CP0)
	6-15	(reserved)
	16	MDT0 length (S-0-1010, list element 0)
	17	MDT1 length (S-0-1010, list element 1)
	18	MDT2 length (S-0-1010, list element 2)
	19	MDT3 length (S-0-1010, list element 3)
	20-31	(reserved for MDT length, MDT4 to MDT15)
	32	AT0 length (S-0-1012, list element 0)
	33	AT1 length (S-0-1012, list element 1)
	34	AT2 length (S-0-1012, list element 2)
	35	AT3 length (S-0-1012, list element 3)
	36-47	(reserved for AT length, AT4 to AT15)
	48-127	(reserved)
	—	Coding of HP1 parameters (128 to 255)
	128	MDT-SVC offset (S-0-1013)
	129	AT-SVC offset (S-0-1014)
	130	Topology index (S-0-1042, if supported)
	131-255	(reserved)

4.5.7.2.4 MDT HP INFO fields (in HP0 and HP1)

The MDT HP INFO field shall always be 4 octets long. If hot-plug data with 2 octets only are transmitted, then the data shall be in the low word, and the high word value shall be “don’t care”.

The MDT HP INFO field shall be the container for the hot-plug data exchange from the master to the HP slave device, which takes place in steps in the MDT HP field.

4.5.7.2.5 MDT Extended field

The Extended field (EF) can be transmitted in the MDT0 behind the hot-plug field (see Table 18). The extended field supports the transmission of time fragments and the TSref-counter.

1) Time fragments: The master transmits its own time (8 octets) in 4 fragments with 2 octets via this field to the slaves. The fragmentation is controlled by 2 bits and the Cycle CNT of MST.
   - Time fragment valid bit is set to 1 by the master if the data in the field "Time fragments" are valid and the Cycle CNT of MST is 0. The master may set this bit to 0 at any time.
   - Activate time: In a continuous transfer of time fragments this bit is toggled when the master has transmitted a new time and the Cycle CNT of MST is 0.
2) TSref-counter: This counter is 14 bits long and counts modulo using the value of parameter S-0-1061.
   - The initial value of the TSref-counter is 0.
   - The master increments the TSref-counter in each communication cycle by 1.

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- The master calculates the Least Common Multiple (LCM) of all producer cycle times and writes the LCM value in S-0-1061. If the TSref-counter reaches the calculated LCM value, then the master set the TSref-counter to 0, and the function is started again (modulo function).

If the SCP_Classes SCP_SYNC 0x02 or SCP_SysTime are activated by the master the Extended field is present in the MDT0 of CP3 and CP4.

Table 18 – Extended Field (EF)

Bit number	Value	Description
31	—	Activate time
	toggle	Master has continuously transmitted a new time. Slave shall set the new time in its internal time system.
30	—	Time fragment valid
	0	Not valid (time fragment not valid. Slave shall not use this time fragment)
	1	Valid (time fragment valid. Slave shall use this time fragment)
29-16		TSref-counter (modulo counter with the Least Common Multiple of different producer cycle times which shall be synchronized)
15-0		Time fragment (fragments of Type 19 current time, multiplexed with Cycle CNT of MST)

4.5.7.3 MDT service channel (SVC) field

4.5.7.3.1 MDT service channel field summary

The MDT service channel field (see Table 19) shall contain all service channels (SVC) of the configured devices within a Type 19 network. Only configured slave devices shall have their own dedicated service channel, depending upon the application, whereas there shall be no restriction regarding device address order.

The service channel for each device shall be as specified in Table 20.

Table 19 – MDT service channel field

DLPDU part	Data field	Data type	Value/Description
MDT service channel field	MDT SVC for slave device #1	octet[6]	—
	MDT SVC for slave device #2	octet[6]	—
	…	…	(And so on for slave device 3 to slave device (N-1))
	MDT SVC for slave device #N	octet[6]	—

Table 20 – MDT SVC (for each slave)

DLPDU part	Data field	Data type	Value/Description
MDT SVC of slave device #k	SVC control	octet[2]	Offset in the MDT defined by S-0-1013 SVC offset in MDT of the assigned slave
	MDT SVC INFO	octet[4]	—

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4.5.7.3.2 SVC control

The content of service channel (SVC) control word shall be as specified in Table 21.

Table 21 – SVC control word (DLL)

Bit number	Bit value	Control word description
15-6	—	(reserved)
5-3	—	Data block element
	000	Service channel not active, close service channel or break a transmission in progress
	001	IDN of the operation data. The service channel is closed for the previous IDN and opened for a new IDN
	010	Name of operation data
	011	Attribute of operation data
	100	Unit of the operation data
	101	Minimum value
	110	Maximum value
	111	Operation data
2	—	Bit last transmission
	0	Transmission in progress
	1	Last transmission
1	—	R/W (read/write)
	0	Read SVC INFO
	1	Write SVC INFO
0	—	MHS (master handshake bit)
	toggle	Service transport handshake of the master

4.5.7.3.3 MDT SVC INFO

The MDT SVC INFO field shall always be 4 octets long. If only 2 octets are transmitted in a step, then the data shall be in the low word, and the high word value shall be “don’t care”.

The MDT SVC INFO field shall be the container for the non-cyclic data exchange from the master to the slave device, which takes place in steps in the MDT SVC field.

4.5.7.4 MDT real-time data field

4.5.7.4.1 General

Each slave shall have only one device control as specified in Table 22.

Each slave can have several connections as specified in Table 23.

The connection data to any one slave device shall not be spread into two different MDTs. There shall be no restriction to the offset parameters (S-0-1009, ,S-0-1050.x.03) regarding device address order.

The master shall at least process the device control and the application data in the corresponding producer cycle time. If a master has several connections with different producer cycle times to one slave, then the device control shall be updated by the master with the fastest producer cycle.

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Table 22 – MDT device control

DLPDU part	Data field	Data type	Value/Description
Real-time data #k	Device control	octet[2]	Offset in the MDT defined by S-0-1009 Device Control (C-DEV) Offset in MDT of the assigned slave

The device control shall be present for each slave exactly once.

Table 23 – MDT application data

DLPDU part	Data field	Data type	Value/Description
Real-time data #k	Application data	Container	Offset in the MDT defined by S-0-1050.x.03 Telegram Assignment of the assigned slave

NOTE The application data may be present for each slave 0-255 times.

The functionality of a connection is described in 4.7

4.5.7.4.2 Device control

The content of device control field shall be as specified in Table 24.

Table 24 – Device control field (C-DEV)

Bit number	Bit value	Description
15	—	Identification
	0	No Identification request
	1	Identification request (slave shows the condition of this bit at the Type 19 LED or at the display). This function is used for the remote address allocation or for configuration errors between master and slave.
14	—	Topology HS (Initial value is 0 in every CP)
	toggle	The master toggles every time it requires a topology change.
13-12	—	Topology control (Master selects the new topology)
	00	Fast-Forward on both ports
	01	Loopback with Forward of P-Telegrams
	10	Loopback with Forward of S-Telegrams
	11	(reserved: slave shall ignore this bit combination)
11	—	Control physical topology (If the slave detects a toggle, then it shall drop the source address table. The control physical topology is used in the UC channel only)
	0	physical ring is broken
	1	physical ring is closed
10-9	—	(reserved)
8	—	Master valid (indicates if the master is processing data. In CP1 the slave detects the support of this function if this bit is set to 1 by the master)
	0	Master is not valid (the master shall set this bit = 0, if the master activates NRT state or CP0. The contents of device control C-DEV are invalid. Producer ready of all producer connections shall be set to 0)
	1	Master is valid (If supported, the master shall set this bit = 1, if the master activates CP1.The contents of

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Bit number	Bit value	Description
		device control C-DEV are valid)
7-0	—	(reserved)

4.6 AT DLPDU

4.6.1 AT header field summary

The AT is a Type 19 telegram and shall be as specified in Table 25. The Type 19 header is called AT header.

Table 25 – AT MST header

DLPDU part	Data field	Data type	Value/Description
AT header	AT type	octet[1]	see 4.6.3
	AT phase	octet[1]	see 4.6.4
	AT CRC	octet[4]	see 4.6.5

4.6.2 Evaluation of AT header in the slaves

The AT header shall be generated by the master and evaluated by the slaves. Each slave shall evaluate the AT header according to Table 26.

Table 26 – AT header fields to be considered by the slave

	AT type	AT phase	AT CRC
AT0	Yes	No	Yes
AT1	Yes	No	Yes
AT2	Yes	No	Yes
AT3	Yes	No	Yes

NOTE The slave has to evaluate the AT type only if the AT CRC is valid.

4.6.3 AT type

Refer to 4.4.2, whereas bit #6 shall be 1.

4.6.4 AT phase

The AT phase shall contain the status of the Type 19 communication during initialization and during CP4. The phase shall be generated by the master and transmitted in every AT. The structure is the same as for MDT phase (see 4.5.4).

The phase of an AT shall not be evaluated by the slave (see Table 26).

4.6.5 AT CRC

The AT CRC shall be generated by the master as the MDT CRC (see 4.5.5).

The AT CRC shall be evaluated by the slave (see Table 26).

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4.6.6 AT Payload during initialization

4.6.6.1 General

The content of the AT payload depends on the communication phase (CP) as described in the following subclauses.

4.6.6.2 AT payload in CP0

The master shall always transmit AT0 telegrams, and no AT1, AT2, nor AT3 telegrams. AT0 shall be structured as stated in Table 27. Table 27 also specifies the AT0 payload data that the master shall fill with initial values. The master shall

- set the sequence counter to 0x0001 and / or to 0x8001 (depending on the related topology);
- fill all topology index fields with 0xFFFF.

Port Px and Py in Table 27 are interchangeable, that means port Px and Py can be port P1 or P2.

Table 27 – AT0 structure in CP0

DLPDU part	Data field	Data type	Value/Description
AT MST	AT type	octet[1]	AT0, see 4.6.3
	AT phase	octet[1]	CP0, see 4.6.4
	AT CRC	octet[4]	see 4.6.5
AT payload	Sequence counter	octet[2]	Initial values:0x0001 (Port Px), 0x8001 (Port Py) Received value (Port Px): 0x08001+number of slaves (with ring) 0x0001+(2*number of slaves)-1 (with line) Received value (Port Py): 0x0001+number of slaves (with ring) 0x8001+(2*number of slaves)-1 (with line)
	Topology index #1	octet[2]	Initial value 0xFFFF (for Port Px and Py) Received value (Port Px and Py): device address if slave present.
	Topology indices #2 to #510	octet[2*509]	Initial value 0xFFFF (for Port Px and Py) Received value (Port Px and Py): device address if slave present.
	Topology address #511	octet[2]	Initial value 0xFFFF (for Port Px and Py) Received value (Port Px and Py): device address if slave present.

The content of topology index field in the AT0 of CP0 shall be as specified in Table 28.

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Table 28 – Topology address in AT0-CP0

Bit No.	Value	Description
Master (15-0)	0xFFFF	set by the master
Slave (15)	—	Support of requested functions in Communication version of MDT0-CP0 (see 5.2.4, Table 9)
	0	Slave doesn't support one or more of the requested functions (default values are activated)
	1	Slave supports all requested functions (values of all requested functions are activated)
Slave (14-9)	—	(reserved)
Slave (8-0)	—	Device addresses
	0-511	Valid device addresses

4.6.6.3 AT payload in CP1 and CP2

The master shall choose between two communication sequences in CP1 and CP2:

a) If the master supports 255 slaves or less, it may transmit either AT0 to AT3 telegrams, or AT0 and AT1 telegrams only, for example to save initialization time. The slaves shall support both sequence options by evaluating the Communication Version (see Table 9).

b) If the master supports 256 slaves or more (up to 511 slaves) it shall transmit AT0 to AT3 telegrams.

The AT data field of the AT0 shall contain the service channel (see 4.6.7.3) and the device status (see 4.6.7.4.2) of topology indices as shown in Table 29, Table 30, Table 31 and Table 32 respectively.

In CP1 the requested slave shall respond by setting the handshake bit (AHS) and valid bit (SVC valid) to 1 in the corresponding SVC status. The AT SVC INFO is “don’t care”.

In the device status the slave shall process the following bits:

a) slave valid bit is set to 1;

b) topology bits are updated;

c) parametrization level and communication error interface are valid.

In CP2 the telegrams shall have the same structure as in CP1, but the contents of AT SVC INFO shall be valid in CP2.

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Table 29 – AT0 in CP1 and CP2 (topology indices 0 to 127)

DLPDU part	Data field	Data type	Value/Description
AT header	AT type	octet[1]	AT0, see 4.6.3
	AT phase	octet[1]	CP1 or CP2, see 4.6.4
	AT CRC	octet[4]	see 4.6.5
AT data field	AT SVC for topology index #0	octet[6]	—
	…	octet[6*126]	(and so on for topology indices #1 to #126)
	AT SVC for topology index #127	octet[6]	—
	Device status for topology index #0	octet[2]	—
	Reserved for topology index #0	octet[2]	—
	…	octet[2*126]	(And so on for topology indices #1 to #126)
	Device status for topology index #127	octet[2]	—
	Reserved for topology index #127	octet[2]	—

Table 30 – AT1 in CP1 and CP2 (topology indices 128 to 255)

DLPDU part	Data field	Data type	Value/Description
AT header	AT type	octet[1]	AT1, see 4.6.3
	AT phase	octet[1]	CP1 or CP2, 4.6.4
	AT CRC	octet[4]	see 4.6.5
AT data field	AT SVC for topology index #128	octet[6]	—
	…	octet[6*126]	(And so on for topology indices #129 to #254)
	AT SVC for topology index #255	octet[6]	—
	Device status for topology index #128	octet[2]	—
	Reserved for topology index #128	octet[2]	—
	…	octet[2*126]	(And so on for topology indices #129 to #254)
	Device status for topology index #255	octet[2]	—
	Reserved for topology index #255	octet[2]	—

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Table 31 – AT2 in CP1 and CP2 (topology indices 256 to 383)

DLPDU part	Data field	Data type	Value/Description
AT header	AT type	octet[1]	AT3, see 4.6.3
	AT phase	octet[1]	CP1 or CP2, 4.6.4
	AT CRC	octet[4]	see 4.6.5
AT data field	AT SVC for topology index #256	octet[6]	—
	…	octet[6*126]	(And so on for topology indices #257 to #382)
	AT SVC for topology index #383	octet[6]	—
	Device status for topology index #256	octet[2]	—
	Reserved for topology index #256	octet[2]	—
	…	octet[2*126]	(And so on for topology indices #257 to #382)
	Device status for topology index #383	octet[2]	—
	Reserved for topology index #383	octet[2]	—

Table 32 – AT3 in CP1 and CP2 (topology indices 384 to 511)

DLPDU part	Data field	Data type	Value/Description
AT header	AT type	octet[1]	AT3, see 4.6.3
	AT phase	octet[1]	CP1 or CP2, 4.6.4
	AT CRC	octet[4]	see 4.6.5
AT data field	AT SVC for topology index #384	octet[6]	—
	…	octet[6*126]	(And so on for topology indices #385 to #510)
	AT SVC for topology index #511	octet[6]	—
	Device status for topology index #0	octet[2]	—
	Reserved for topology index #0	octet[2]	—
	…	octet[2*126]	(And so on for topology indices #385 to #510)
	Device status for topology index #511	octet[2]	—
	Reserved for topology index #511	octet[2]	—

4.6.6.4 AT payload in CP3

In CP3, the master shall transmit ATs with the same structure as in CP4. The slaves insert their data in the corresponding data fields.

In CP3, only the service channel and the device status shall be valid. The configurable application data in the connections of the ATs shall not be evaluated, but they shall have the number of octets required for CP4. The positions of the service channels and the connections

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in the AT relevant to the individual slaves shall be as transmitted by the master to the slaves during CP2 with the corresponding communication parameters.

4.6.7 AT payload in CP4

4.6.7.1 Introduction

In CP4, the master shall transmit ATs with the same structure as in CP3. The slaves insert their data in the corresponding data fields.

In CP4, the configurable real-time data shall be valid and filled with actual values as determined by the parameters that the master transmitted to the slaves during CP2. The connection control and the resource status which depend on the application profile shall be valid.

The AT payload of AT0 (see Table 33) shall always contain

- one AT0 hot-plug field and depending on the configuration;
- several service channels, one per slave only;
- several device status, one per slave only;
- several connections.

The AT payload of AT1 to AT3 (see Table 33) can contain depending on the configuration

- several service channels, one per slave only;
- several device status, one per slave only;
- several connections.

The AT payload structure shall be as specified in Table 33.

Table 33 – AT data field

DLPDU part	Data Field	Data Type	Value/Description
AT data field	AT0 hot-plug field	octet[8]	in AT0 only, see 4.6.7.2
	AT service channels	octet[see 4.6.7.3]	Optional. see 4.6.7.3
	AT real-time data	octet[see 4.6.7.4]	Optional. see 4.6.7.4

For each slave,

- IDN S-0-1014 (SVC offset in AT) shall set the offset for its service channel;
- IDN S-0-1011 (Device status S-DEV) shall set the offset for the device status;
- IDN S-0-1050.x.3 (Telegram assignment) shall set the offset for the connection data;
- IDN S-0-1050.x.5 (Current length of connection) shall contain the length of the connection data;
- IDN S-0-1012 (Length of ATs) shall contain the length of the ATs (see Figure 2).

These parameters shall be transmitted from the master to the slaves in CP2.

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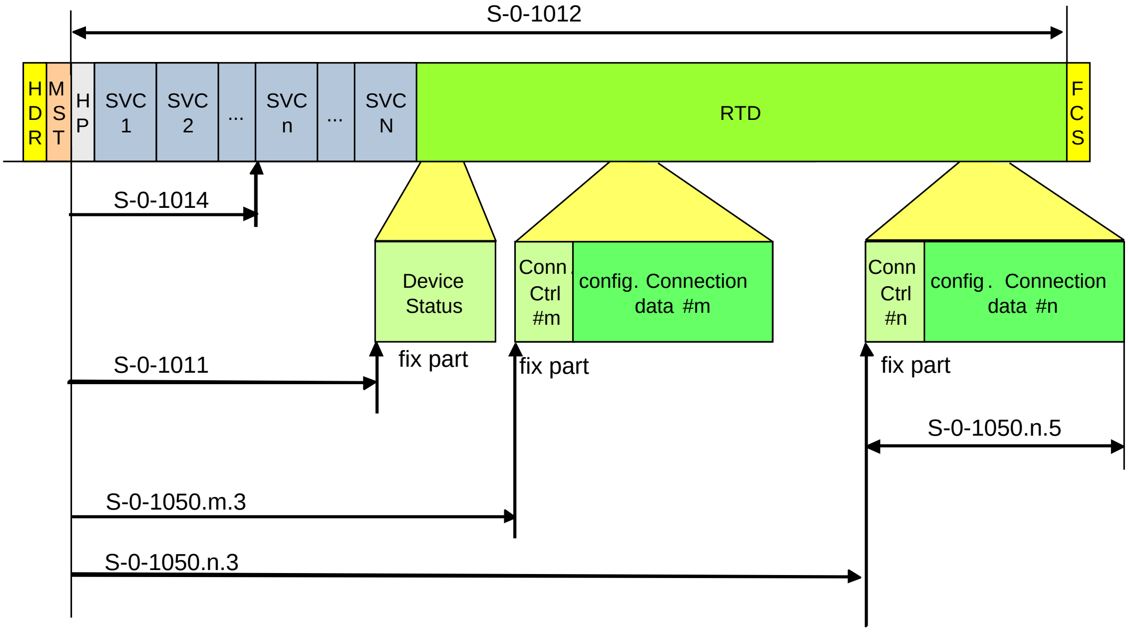

Figure 2 – Example of Offsets within AT payload

4.6.7.2 AT hot-plug field

4.6.7.2.1 AT hot-plug field summary

The structure of the AT hot-plug field shall be as specified in Table 34, depending upon hot-plug phases (see 5.5).

Table 34 – AT hot-plug field in HP0 and HP1

DLPDU part	Data field	Data type	Value/Description
AT hot-plug field	AT-HP address	octet[2]	see 4.6.7.2.2
	HP status	octet[2]	S-HP, see 4.6.7.2.3
	AT-HP INFO	octet[4]	(reserved, see 5.5)

4.6.7.2.2 AT-HP address field

The content of HP address field in the AT shall be as specified in Table 35.

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Table 35 – HP address in AT-HP field

Bit number	Value	Description
15-12	—	Slave index specifies the number of slaves within one device (device can contain multiple slaves)
	0..15	Slave index (set by slave in HP1)
11-0	—	Device addresses
	0-511	Device addresses for operation (set by slave in HP1 and HP2)
	512-4092	(reserved)
	4093	End of scanning of slave indices (an unused index was detected by the HP slave), set by slave in HP1
	4094	(reserved)
	4095	(reserved)

4.6.7.2.3 HP status field (in HP0 and HP1)

The content of HP status field shall be as specified in Table 36.

Table 36 – HP status field (in HP0 and HP1)

Bit number	Value	Description
15-9	—	(reserved)
8	—	HP Condition
	0	Acknowledgment in HP1 (code see bit 7-0)
	1	Error in HP1 (error code see bit 7-0)
7-0	—	HP1 acknowledgment or error codes
	0	(reserved)
	1	Acknowledgment: No data in AT-HP INFO (bit 8=0, AT-HP INFO is “don’t care”)
	2	Error: SVC activation (bit 8 = 1, error occurs during activating of SVC in the HP slave)
	3	(reserved)
	4	Error: device address (bit 8 = 1, master does not transmit the sercos address of the HP slave)
	5	Error: Slave scan (bit 8 = 1, master did not scan all slaves in a multi slave device)
	6 to 127	(reserved)
	128	MDT-SVC pointer (shall be supported bit 8 = 0 --> no error, parameter valid bit 8 = 1 --> error, parameter invalid)
	129	AT-SVC pointer (shall be supported bit 8 = 0 --> no error, parameter valid bit 8 = 1 --> error, parameter invalid)
	130	Topology index
	131 to 254	(reserved)
	255	Error: HP slave receives its own device address on its inactive port (bit 8 = 1 --> next HP slave connected to this HP slave has the same device address)

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4.6.7.3 AT service channel field

4.6.7.3.1 AT service channel fields summary

The AT service channel field (see Table 37) shall contain all service channels (SVC) of the configured devices within a Type 19 network.

Each configured slave shall have its own dedicated service channel, depending upon the application, whereas there shall be no restriction regarding device address order.

The service channel for each slave shall be as specified in Table 38.

Table 37 – AT service channel field

DLPDU part	Data field	Data type	Value/Description
AT service channel field	AT SVC for slave # 1	octet[6]	see Table 38
	AT SVC for slave #2	octet[6]	see Table 38
	…	…	(And so on for slaves #3 to slaves #(N-1))
	AT SVC for slave #N	octet[6]	see Table 38

Table 38 – AT SVC (for each slave)

DLPDU part	Data field	Data type	Value/Description
AT SVC of slave device #k	SVC status	octet[2]	Offset in the AT defined by S-0-1014 (SVC offset in AT) of the assigned slave.
	AT SVC INFO	octet[4]	—

4.6.7.3.2 AT SVC status

The structure of SVC status shall be as specified in Table 39.

Table 39 – AT SVC status description (DLL)

Bit number	Bit value	Description
15-4	—	(reserved)
3	—	SVC processing
	0	SVC invalid (slave doesn't process AT SVC in this P channel or S channel)
	1	SVC valid (slave processes AT SVC in this P channel or S channel)
2	—	SVC error
	0	No error
	1	Error in SVC (error message in SVC INFO)
1	—	Busy
	0	Step finished (slave ready for new step)
	1	Step in process (new step not allowed)
0	—	AHS
	toggle	SVC transport handshake of the slave (toggle bit)

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4.6.7.3.3 AT SVC INFO

The AT SVC INFO field shall always be 4 octets long. If only 2 octets are transmitted in one step, then the data shall be in the low word, and the high word value shall be “don’t care”.

The AT SVC INFO field shall be the container for the non-cyclic data exchange from any slave to the master, which takes place in steps in the AT SVC field of the telegram.

4.6.7.4 AT real-time data field

4.6.7.4.1 General

Each slave shall have only one device status (see Table 40).

Each slave can have several connections as specified in Table 41.

The connection data to any one slave device shall not be spread into two different ATs. There shall be no restriction to the offset parameters (S-0-1009, S-0-1050.x.03) regarding device address order.

The slave shall at least process the device status and the application data in the corresponding producer cycle time. If a slave has several connections with different producer cycle times to the master or to other slaves, then the device status shall be updated by the slave with the slowest producer cycle.

Table 40 – AT device status

DLPDU part	Data field	Data type	Value/Description
Real-time data #k	Device status	octet[2]	Offset in the AT defined by S-0-1011 Device Status S-DEV Offset in AT of the assigned slave

The device status shall be present for each slave exactly once.

Table 41 – AT connection data

DLPDU part	Data field	Data type	Value/Description
Real-time data #k	Application data	Container	Offset in the AT defined by S-0-1050.x.03 (Telegram Assignment) of the assigned slave

NOTE The application data may be present for each slave 0-255 times.

The functionality of a connection is described in 4.7

4.6.7.4.2 Device status (S-DEV)

The content of device status field shall be as specified in Table 42.

The fastest reaction time to any event affecting device status except bits 11-10 (Status of inactive port) shall be within the slowest producer cycle time but at most 200 ms.

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Table 42 – Device status field

Bit number	Bit value	Description
15	—	Communication warning interface
	0	No warning
	1	Communication warning occurred (for example: number of permitted MST losses has exceeded the half value of S-0-1003)
14	—	Topology HS
	toggle	Initial value is 0 in every CP. Slave toggles, if the request of the master has been recognized, that means, the topology status may be updated after the toggle.
13-10	—	Topology status / Port status
	00-00	Fast-Forward on both ports (Diagnostic not available)
	01-00	Loopback with Forward of P-Telegrams (no link on inactive port --> no device connected)
	01-01	Loopback with Forward of P-Telegrams (LINK on inactive port --> device connected)
	01-10	Loopback with Forward of P-Telegrams (P LINK: P telegrams on inactive port --> Type 19 device connected)
	01-11	Loopback with Forward of P-Telegrams (S LINK: S telegrams on inactive port --> Type 19 device connected)
	10-00	Loopback with Forward of S-Telegrams (no link on inactive port --> no device connected)
	10-01	Loopback with Forward of S-Telegrams (LINK on inactive port --> device connected)
	10-10	Loopback with Forward of S-Telegrams (P-LINK: P telegrams on inactive port --> Type 19 device connected)
	10-11	Loopback with Forward of S-Telegrams (S-LINK: S telegrams on inactive port --> Type 19 device connected)
	11-xx	store & forward or cut-through
	00-xx	Additional bit combinations:
	00-01	fast-forward on both ports (Diagnostic supported)
	00-10	fast-forward on both ports (error in P channel)
	00-11	fast-forward on both ports (error in S channel)
9	—	Error connection
	0	Error-free connection
	1	Error in the connection occurred (consumer recognized an error in a connection)
8	—	Slave valid (indicates if a slave is processing data)
	0	Slave not valid (Set to 0 when entering CP0. Modified during CPS. The contents of device status S-DEV are invalid. Producer ready of all producer connections shall be set to 0)
	1	Slave valid (CP > CP0. Modified during CPS the contents of device status (S-DEV) are valid)
7	—	Error (C1D), inclusive sub-device and resource errors
	0	No error
	1	Error (detailed information is shown in S-0-0390)
6	—	Warning (C2D), inclusive sub-device and resource warnings

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Bit number	Bit value	Description
	0	No Warning
	1	Warning (detailed information is shown in S-0-0390)
5	—	Procedure command change bit
	0	No change in procedure command acknowledgement
	1	Changing procedure command acknowledgment (procedure command is positive or negative acknowledged)
4	—	Sub-device level
	0	Operating level (OL) is active
	1	Parametrization level (PL) is active
3	—	(reserved)
2	—	(reserved)
1-0	—	(reserved)

4.7 Mechanisms of connections

4.7.1 Introduction

The communication connects all participants in a network. Because of this, it is possible that each participant is able to communicate with any other. A connection determines which participants communicate together. The Type 19 network supports the application data exchange between the master and all slaves, and between the slaves in both directions. Not all participants need to communicate with each other, therefore, the application data exchange between the participants are configured via connections. The connection functionality is based on a producer-consumer model. That means, for each transmission of application data, one connection is required.

A connection shall have one producer only, but it can have no consumer or several consumers. In the S-0-1050.x.01 (Connection setup) the participant gets the info, whether the connection is configured as a producer or consumer. The connection control is a fixed part of each connection and is configured automatically. The transmitted application data of the connection are configurable.

Description and definitions of Figure 5:

- write: Application writes application data and signals it to the producer
- produce & set: First, the producer inserts application data into the connection, then it sets the connection control (C-Con) related to producer state machine
- evaluate & consume: First, the consumer evaluates the connection control (C-Con), then it consumes application data from the connection and signals it to the application
- read: Application reads application data from the consumer.

Flow of application data from application to application:

a) The application (e.g. control unit, drive, IO, etc.) generates the application data and writes it to the producer.
b) The producer is informed also and selects the corresponding state of the state machine and produces the application data into the connection and sets the connection control based on the producer state's conditions.
c) The communication transmits all connections with the application data within the Type 19 telegrams.
d) The consumer evaluates the connection control and consumes the application data based on the consumer state's conditions.

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e) The application is informed by the consumer and reads the application data.

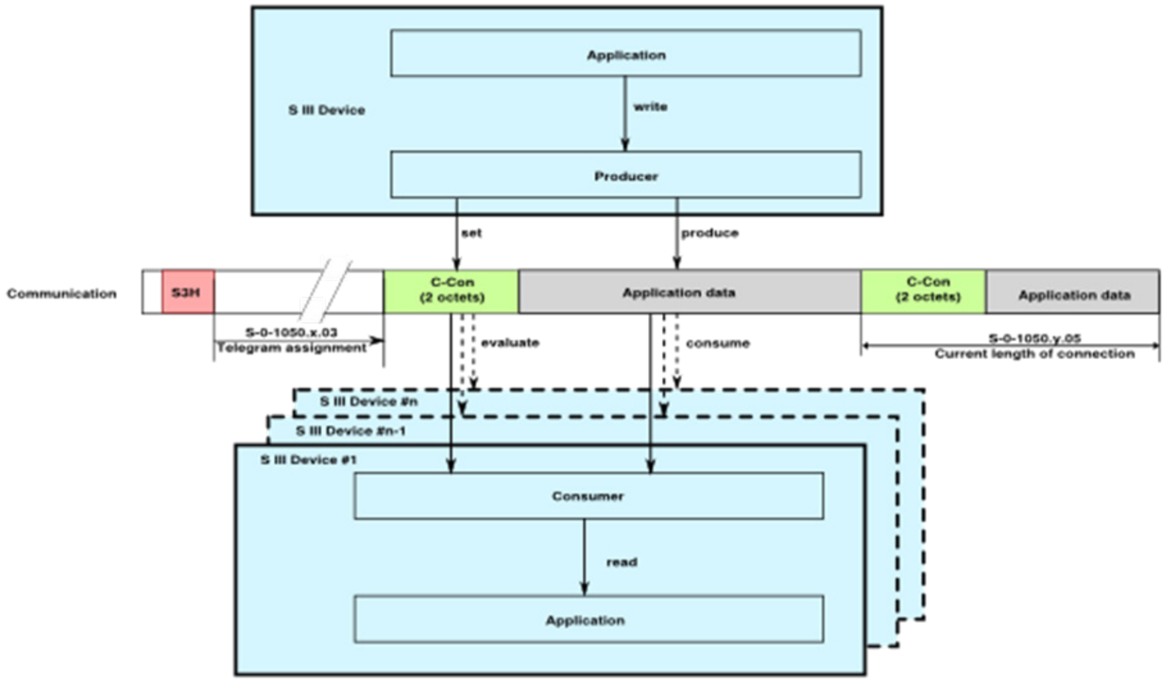

Figure 3 – Flow of application data

4.7.2 Configuration of connections

The configuration of the application data is done using S-0-1050 (Connections). It shall be assigned to a slave during initialization in CP2. All configured application data in a connection shall be write protected in CP3 and CP4.

The configuration rules of connections are the following:

- Only operation data shall be used.
- For operation data with fixed length the determined data length in the attribute is used.
- For operation data with variable length, the current data length used in the connection shall be round up to an even number of octets. The 4 octets length indicators are not part of the application data.
- Each operation data shall start at an even number of octets within the connection.
- The structure of the connection shall be determined by S-0-1050.x.06 (Configuration List), see Table 43.

The connection shall be as configured in S-0-1050.x.01 (Connection setup). This connection connects one producer to all consumers. Depending upon configuration, the application data shall be either:

- configurable by the master during initialization; see S-0-1050.x.06 (Configuration List);
- configurable by the slave during initialization, for example S-0-1500.x.05 (Container OutputData) or S-0-1500.x.09 (Container InputData);
- as specified in the telegram type parameter S-0-0015 (Telegram type).

The position of the connection within a Type 19 telegram is defined by the S-0-1050.x.03 (Telegram Assignment) and the S-0-1050.x.05 (Current length of connection), see Figure 4.

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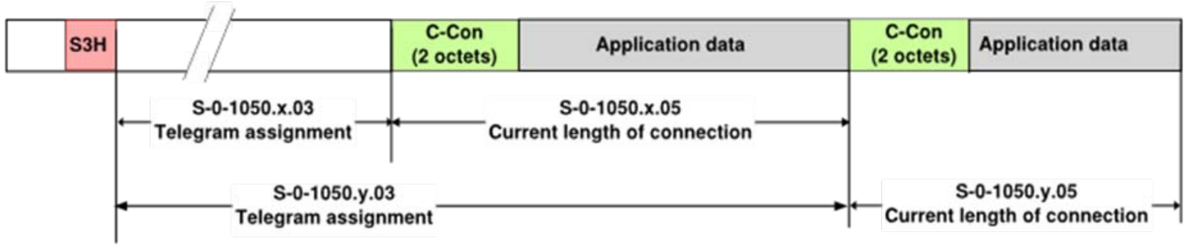

Figure 4 – Telegram assignment and connection length

Table 43 – Structure of the connection

Frame part	Data field	Data type	Value/Description
Slave #k configurable application data	Connection control	octet[2]	Offset in the MDT or AT defined by S-0-1050.x.03 (Telegram Assignment) of the assigned slave
	Operation data IDN …	octet[depending upon IDN]	Number and length of operation data k shall be configured in S-0-1050.x.06 (Configuration List) or by the selected standard telegram S-0-0015 (Telegram type)
	Operation data IDN …	octet[depending upon IDN]	
	…	…	
	Operation data IDN …	octet[depending upon IDN]	

4.7.3 Connection control

The connection control shall be set as specified in Table 44. The Connection Control (C-CON) are the first two octets of each connection.

Table 44 – Connection control (C-CON)

Bit number	Bit value	Description
15-12		Counter: - initial value of this counter is 0 in CP4 - every change of this counter announces new application data in the connection and the application data may be processed - at a cycle synchronous connection this counter shall always be increased in the related communication cycle - at a non-synchronous connection the change of this counter triggers a watchdog, i.e. after change of this counter the monitoring time (tPcyc) is always started again. This counter shall be increased once per monitoring time (tPcyc), after producer ready (bit 0) is set to 1 - Bit 12 shall be equal to bit 1 (new data)
11-8	—	(reserved)
7		Real-time bit 2 (part of application data, description see FG_RTB)
6		Real-time bit 1 (part of application data, description see FG_RTB)
5	—	(reserved)
4	—	Flow-control (description see 4.7.4 and 4.7.5)
	0	Run (producing and consuming are active)
	1	Stop (the producing is canceled, the consumer shall not generate an error)
3	—	(reserved)
2	—	Data field delay (the consumer shall prefer taking the application data of the port at which this bit has the value 0)
	0	No delay (application data are transmitted without delay in the same

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Bit number	Bit value	Description
		communication cycle)
	1	Delay (master has copied the application data and therefore the application data are transmitted with additional delay of one communication cycle)
1	—	New application data
	toggle	- initial value of this bit is 0 in CP4 - every toggle of this bit announces new application data in the connection and then the application data are exchanged between connection and application. This implies, that in the consumer - when the application data of a certain producer cycle has not been received, the prospected value for this bit has also to be toggled for the next communication cycle. - at a clock synchronous or cyclic connection this bit shall always be toggled in the related communication cycle. - at a non-synchronous connection this bit triggers a watchdog, i.e. after toggle of this bit the monitoring is always started again with the monitoring time (tPcyc). This bit shall be toggled once per monitoring time (tPcyc), after producer ready (bit 0) is set to 1. - Bit 1 shall be equal to bit 12 (LSB of counter).
0	—	Producer ready If master valid resp. slave valid is set to 0, this bit shall be set to 0 also.
	0	Not valid (the producer does not generate any application data in this connection yet)
	1	Valid The producer generates application data in this connection. The consumer can process the application data if the producer has toggled the new data (bit 1). The producer ready bit shall be evaluated in CP4 only.

The connection control state machines of producer and consumer describe the dynamic behavior of establishing and releasing connections. The producer is the active part that provides application data and determines when the connection is activated or deactivated. The consumer waits for valid application data and reacts on state switches of the producer. The producer and the consumer provide their connection state in S-0-1050.x.09 (Connection State). The producer also provides the S-0-1050.x.08 (Connection Control C-CON).

4.7.4 Producer state machine

In addition to S-0-1050.x.09 (Connection State), the producer signals its current state to the consumer by setting corresponding bits in the connection control (C-CON). The initial state of the producer is “init”. In this state the producer is waiting for CP4. By reaching CP4, the producer shall change to state “network in operation (CP4)”. As long as the system is in CP4, the producer shall stay in this state. The state “network in operation (CP4)” includes a sub-state machine, which describes the current producing state of the producer. The producer can change its sub-states among “prepare”, “ready”, ”producing”, “stopping” and "waiting". If the communication leaves CP4, the producer state machine shall go back to “init” state (see Figure 5).

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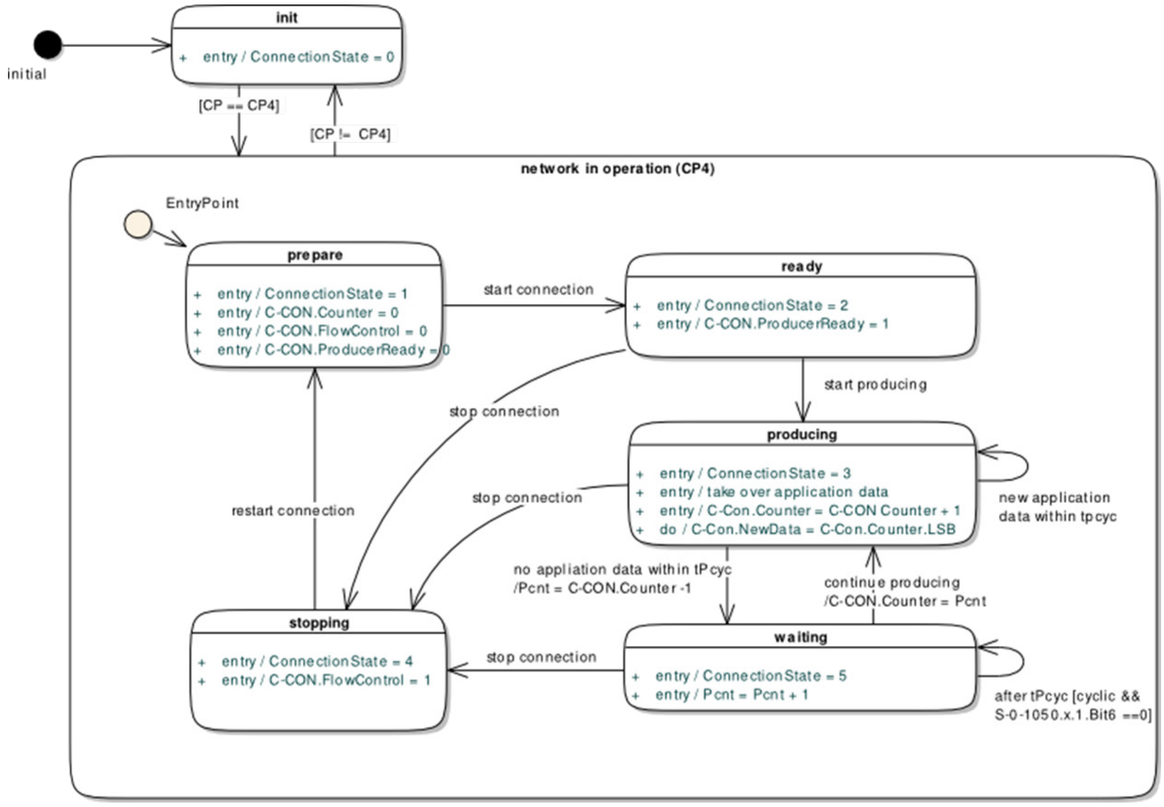

Figure 5 – Connection control state machine producer

NOTE Pcnt is an internal counter of the producer.

Table 45 shows valid bit combination's of the connection control in each producer state.

Table 45 – Connection control combinations

State	Name	Connection control (C-CON)		
		Producer Ready	**Flow control**	**Counter / New data**
0	Init	x	x	X
1	Prepare	0	0	0
2	Ready	1	0	0
3	Producing	1	0	+1
4	Stopping	1	1	no change
5	Waiting	1	0	no change

Table 46 shows the states of the producer state machine.

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Table 46 – States of the producer state machine

State	Description
init	Starting the state machine, the producer shall start and stay in this state as long as the communication phase is not CP4. Entering this state, the connection state shall be set to 0. The connections are configured by the master or configurator and checked by the slaves.
Network in operation (CP4)	In this state the communication phase is CP4 and the producer handles the sub-state machine depending on the application data.

Table 47 shows the states of the producer sub-state machine.

Table 47 – States of the producer sub-state machine

State	Description
Prepare	In this state the producer prepares the connection. Entering the “prepare” state, the producer shall reset the C-CON.FlowControl, C-CON.ProducerReady and C-CON.Counter to 0. The connection state shall be set to 1. Having prepared the connection, the producer is allowed to start the connection and switch to “ready” state.
Ready	The producer is ready to transmit application data and shall set the C-CON.ProducerReady to 1. Entering this state the connection state shall be set to 2. The transition to state “producing” shall be performed by the producer dependent on the application. NOTE As fast as possible the application shall start producing independent of the state of all consumer connections.
Producing	In this state the producer shall produce valid application data and shall increase the C.CON.Counter by 1 as configured in S-0-1050.x.01. The C-CON.NewData is set to C-CON.Counter.LSB. Entering this state, the connection state shall be set to 3.
Waiting	The producer waits for new application data. The Pcnt is initialized with the C-CON.Counter – 1. Entering this state the internal producer counter Pcnt is incremented by 1 in each producer cycle as configured in S-0-1050.x.01. The connection state shall be set to 4.
Stopping	The producer stops producing application data. Entering this state the C-CON.FlowControl shall be set to 1 and the application data becomes invalid. The connection state shall be set to 5.

The producer transitions can be described as followed:

Table 48 – Producer transitions

Transition			Description
Source	Target	Condition	
Init	Network in operation (CP4)	CP == CP4	If the communication reaches CP4, then the producer shall switch from “init” to “network in operation (CP4)”. The sub-state machine "network in operation (CP4)" starts with sub-state “prepare”.
Network in operation (CP4)	Init	CP != CP4	If the communication leaves CP4, then the producer shall switch to the state “init”.
Prepare	Ready	Start connection	The producer is ready to transmit application data and switches to “ready” state autonomous.
Ready	Producing	Start producing	The producer takes over new application data.
Producing	Producing	tPcyc	In every producer cycle time (tPcyc) the producer application data and remains in state “producing”.
Producing	Waiting	No new application data	The producer didn’t receive new application data within this producer cycle and shall copy

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Transition			Description
Source	Target	Condition	
			the C.CON.Counter - 1 to Pcnt. The producer shall switch to state "waiting".
Waiting	Waiting	After tPcyc	In every producer cycle time (tPcyc) and S-0-1050.x.01, bit 6 = 0 (with expectation) the producer increments the Pcnt by 1 and remains in the state “waiting”.
Waiting	Producing	Continue producing	The producer receives new application data continues producing and shall copy the Pcnt to the C-CON.Counter.
Ready	Stopping	Stop connection	The producer stops the connection and switches to state “stopping”. In order to produce application data again, the connection has to be restarted.
Producing	Stopping	Stop connection	The producer stops producing application data and switches to state “stopping”. In order to produce application again, the connection has to be restarted.
Waiting	Stopping	Stop connection	The producer stops the connection and switches to state “stopping”. The producer shall set the C-CON.FlowControl to 1. In order to produce application data again, the connection has to be restarted.
Stopping	Prepare	Restart connection	The producer restarts the connection and switches to state “prepare”.

4.7.5 Consumer state machine

The initial state of the consumer is “init” (Figure 6). In this state the consumer shall wait until the communication is switched to CP4. If the communication is in CP4, the consumer shall switch the consumer state to “network in operation (CP4)” and enter the consumer sub-state machine in state “prepare”. Further state switches of the consumer are driven by the producer. The consumer reacts on changing connection control bits (C-CON) of the producer or the communication leaves CP4. The only exception is the recovery from state “error” to “prepare”, which can be initiated by executing procedure command S-0-0099 (Reset class 1 diagnostic).

The standard procedure of consuming application data is switching from “prepare”, through “waiting” to “consuming” state. A consumer in “consuming” state can be stopped using the state “stopped”. If application data losses occur, the consumer shall change from “consuming” to “warning” state and increments the S-0-1050.x.12 Error Counter Data Losses. If errors occur, the consumer shall change from “warning” to “error” state. The consumer shall signal errors using the device status bit S-DEV.ConnError.

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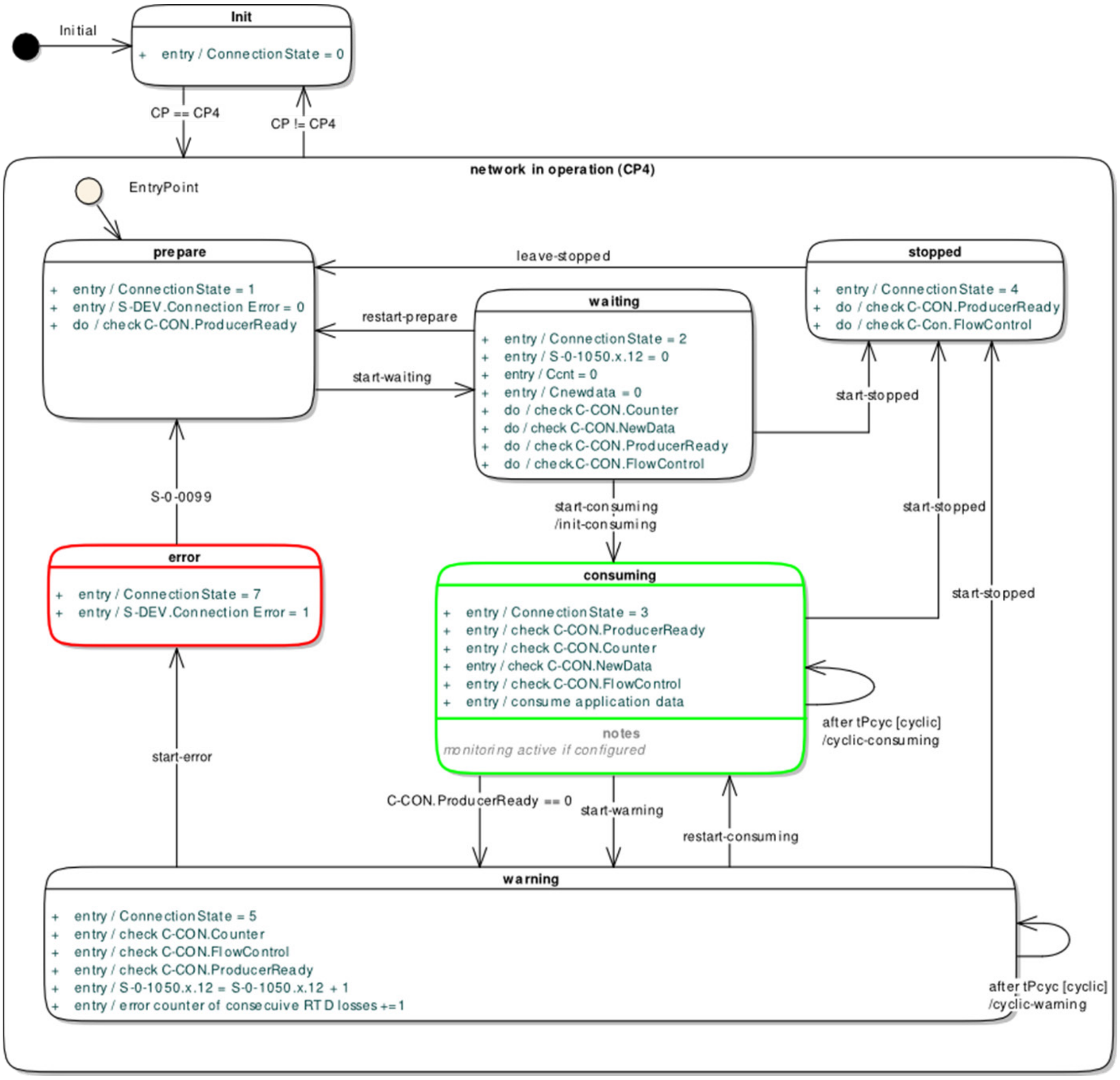

Figure 6 – Connection control state machine consumer

NOTE 1 Ccnt is an internal counter of the consumer and is used to check the C-CON.Counter.

NOTE 2 Cnewdata is an internal bit of the consumer and is used to check the C-CON.NewData.

Table 49 and Table 50 show the states of the consumer state machine and the consumer sub-state machine.

Table 49 – States of the consumer state machine

State	Description
init	Starting the state machine, the consumer shall start and stay in this state as long as the communication phase is not CP4. Entering this state, the connection state shall be set to 0. The connections are configured by the master or configurator and checked by the slaves.
network in operation (CP4)	In this state the communication phase is CP4 and the consumer reacts on information given by the producer. If the communication leaves CP4, then the consumer switches to “init”.

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Table 50 – States of the consumer sub-state machine

State	Description
prepare	The consumer prepares the connection, shall set the connection state to 1 and shall reset the device status bit (S-DEV.Connection Error) to 0. The consumer shall check the C-CON.Producer-ready.
waiting	Entering this state, the connection state shall be set to 2, the S-0-1050.x.12 (Error Counter Data Losses) and the consumer internal Cnewdata bit resp. counter Ccnt shall be set to 0. Within this state, the consumer shall check the connection control (C-CON) defined as follows: - The consumer shall check the C-CON.Counter and C-CON.NewData to determine if the C-CON.Counter is supported by the producer. If this is the case, then the consumer shall use the C-CON.Counter for the consumer state machine only. - The consumer shall check the C-CON.ProducerReady. - The consumer shall check the C-CON.FlowControl.
consuming	In state “consuming”, the connection state shall be set to 3 and the application data of the producer shall be consumed by the consumer. In addition, the consumer shall check the connection control (C.CON) defined as follows: - If the producer cancels the producing and sets the C-CON.ProducerReady = 0, then the application data becomes invalid. The consumer shall not consume the application data. - The consumer shall check the C-CON.FlowControl. - If the corresponding expectation is not fulfilled of the configured method, then the consumer recognizes losses of application data in this producer cycle and shall not consume the application data. - For non-synchronous consumer with watch-dog: If the consumer evaluates the C-CON.Counter in a frequency of its modulo (16 times), then the consumer recognizes losses of application data. - If the corresponding expectation is fulfilled of the configured method in S-0-1050.x.01, bit 6, then the consumer shall consume the application data. - The internal "error counter of consecutive data losses" shall be set to 0, if a change of C-CON.NewData or C-CON.Con-counter is detected.
warning	In state "warning" the connection state shall be set to 5. In addition, the consumer shall check the connection control (C.CON) defined as follows: - The consumer shall check C-CON.FlowControl. - The consumer shall increment the S-0-1050.x.12 Error Counter Data Losses by 1 in each producer cycle (tPcyc). - The consumer shall increment the internal "error counter of consecutive data losses" by 1 in each producer cycle (tPcyc). - If the C-CON.ProducerReady = 0, then the consumer interrupts the consuming and waits until the C-CON.ProducerReady is set to 1 again by the producer. - The consumer shall check if the internal "error counter of consecutive data losses" exceeds S-0-1050.x.11 Allowed Data Losses. - The consumer shall check if the internal "error counter of consecutive data losses" didn’t exceed S-0-1050.x.11 Allowed Data Losses and the application data are valid again (C-CON.ProducerReady = 1).
stopped	In this state the connection state shall be set to 4 and the consumer shall wait for a connection restart. The consumer shall check the C-CON.ProducerReady and the C-CON.FlowControl.
error	In this state the connection state shall be set to 7 and the consumer shall set the status device bit S-DEV.ConnError to 1 and set the S-0-0390 Diagnostic number to 0xC30F4002. The consumer shall check if S-0-0099 (Reset class 1 diagnostic) is activated.

Table 51 shows the consumer transitions.

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Table 51 – Consumer transitions

Transition			Description
Source	**Target**	**Condition**	
init	network in operation (CP4) state = prepare	CP == CP4	If the communication reaches CP4, then the consumer shall switch to state “network in operation (CP4)”. The sub-state machine starts with sub-state “prepare”.
network in operation (CP4)	init	CP != CP4	If the communication leaves CP4, then the consumer shall switch to state “init”.
prepare	waiting	start-waiting C-CON.ProducerReady == 1	If the C-CON.ProducerReady is set to 1, then the consumer shall switch to state “waiting”.
waiting	prepare	restart-prepare C-CON.ProducerReady == 0	If the C-CON.ProducerReady is set to 0 on both ports (P1 and P2), then the consumer shall switch to state “prepare”. All other bits in the C-CON are don't care.
waiting	stopped	start-stopped C-CON.ProducerReady == 1 && C-CON.FlowControl == 1	The producer stops the connection by setting the C-CON.FlowControl to 1 and the C-CON.ProducerReady is 1, then the consumer shall switch to state “stopped”.
warning	stopped	start-stopped C-CON.ProducerReady == 1 && C-CON.FlowControl == 1	The producer stops the connection by setting the C.CON.FlowControl to 1. In this case the consumer shall switch to state “stopped”.
consuming	stopped	start-stopped C-CON.ProducerReady == 1 && C-CON.FlowControl == 1	The producer stops the connection by setting the C.CON.FlowControl to 1. In this case the consumer shall switch to state “stopped”.
stopped	prepare	leave-stopped C-CON.ProducerReady == 0 or C-CON.FlowControl == 0	The producer restarts the connection by setting the C.CON.ProducerReady to 0. In this case the consumer shall switch to state “prepare”.
consuming	warning	C-CON.ProducerReady == 0 (shall be fulfilled on both ports)	If the C-CON.ProducerReady is set to 0 on both ports (P1 and P2) during consuming, then the consumer doesn’t receive valid application data anymore and shall switch to state "warning". All other bits in the C-CON are don't care.
warning	error	start-error ("error counter of consecutive data losses") > S-0-1050.x.11 Allowed Data Losses	If the C-CON.ProducerReady is 1 and C-CON.FlowControl is 0 and the internal "error counter of consecutive data losses" exceeds S-0-1050.x.11 Allowed Data Losses, then the consumer shall switch to state “error”.
error	prepare	S-0-0099 Reset class 1 diagnostic	The error is reset with executing S-0-0099 Reset class 1 diagnostic. The consumer shall set the status device bit S-DEV.ConnError to 0 and shall switch to state “prepare”.
waiting	consuming	start-consuming (init consuming) C-CON.ProducerReady==1 && C-CON.FlowControl==0	C-CON.NewData!=Cnewdata: If the C-CON.NewData ≠ Cnewdata, then the consumer shall initialize the internal bit Cnewdata = C-CON.NewData and switch to state “consuming”. C-CON.Counter!=Ccnt: If the C-CON.Counter ≠ Ccnt, then the consumer shall initialize the internal Ccnt = C-CON.Counter and switch to state “consuming”.
warning	consuming	C.CON.Counter != CNT && C.CON.ProducerReady == 1	The producer produces valid application data again and the amount of consecutive RTD losses didn’t exceed the S-0-1050.x.11 (Allowed Data Losses), then the

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Transition			Description
Source	Target	Condition	
			consumer switches to state "consuming".
consuming	consuming	after tPcyc cyclic consuming C-CON.ProducerReady == 1 && C-CON.FlowControl == 0	If C-CON.ProducerReady is 1 and C-CON.FlowControl is 0, then the consumer consumes application data in every producer cycle time (tPcyc) and remains in the state "consuming".
consuming	warning	start-warning C-CON.ProducerReady == 1 && C-CON.FlowControl == 0	If the check of C-CON.NewData was erroneous, then the producer doesn't increase the C-CON.NewData correctly. In this case the application data are invalid and the consumer shall switch to state "warning". If the check of C-CON.Counter was erroneous, then the producer doesn't increase the C-CON.Counter correctly. In this case the application data are invalid and the consumer shall switch to state "warning".
warning	warning	after tPcyc cyclic warning C-CON.ProducerReady == 0	If C-CON.ProducerReady is 0, then the consumer shall increment the S-0-1050.x.12 Error Counter Data Losses and the internal "error counter of consecutive data losses" by 1 in every producer cycle time (tPcyc). The consumer remains in the state "warning".
warning	consuming	restart-consuming C-CON.ProducerReady == 1 && C-CON.FlowControl == 0	If the producer produces application data again (C-CON.ProducerReady is 1 and C-CON.FlowControl is 0) and the internal "error counter of consecutive data losses" didn't exceed the S-0-1050.x.11 Allowed Data Losses, then the consumer switches to state "consuming". The following condition shall correspond to the expectation.

5 DL management

5.1 Overview

DL-management procedures are functionally processed in response to DL-management service requests submitted by the DL-user and events caused by the network.

5.2 Initialization of cyclic communication

5.2.1 Introduction

Upon an Initiate_cyclic_communication (ICC) request by the DL user in the master device, the so-called phase upshift is initiated.

A Notify_cyclic_communication (NCC) indication is generated for the DL user in the slave device if the phase upshift has been successfully completed.

Upon a Disable_cyclic_communication (DCC) request by the DL user in the master device the so-called phase downshift is initiated.

A Notify_cyclic_communication_disabled (NCCD) indication is generated for the DL user in the slave device if the cyclic communication has been disabled.

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A Notify_error (NER) indication is generated for the DL user in a master and a slave device if an error has occurred in the cyclic communication.

5.2.2 Communication phases (CP)

5.2.2.1 General

Initialization shall be divided into five communication phases and NRT state:

a) After a station has been powered up, and internal checks are completed and error-free, it shall operate in Non-Real-Time (NRT) state (see 5.2.2.2.2).
b) initialization of a Type 19 network shall always beginning with CP0;
c) CP0 shall be used for recognizing the participating slaves;
d) CP1 shall be used to configure the slave devices for non-cyclic communication;
e) CP2 shall be used to configure the slave devices for cyclic communication and for parameter setting in the slave via non-cyclic communication;
f) CP3 shall be used to further configure the slave devices, the cyclic communication shall already be running but shall not be used;
g) in CP4 the initialization process is complete and the Type 19 network shall be in operation.

It shall also be possible to enter CP0 from any higher phase. It shall not be possible to enter other phases except when leaving the previous one in ascending order.

The master shall initiate a specific CP by setting the MDT phase in the Type 19 DLPDUs (see 4.5.4). The slaves shall follow accordingly. Only in the case of a communication error, the slaves shall switch to NRT state.

If a slave is connected to an already operational network and receives a MST that indicates CP4, then it shall enter the hot-plug procedure (see 5.5) if it is supported. Otherwise, the slave remains in NRT state.

The communication phase state machine is shown on the left side of Figure 7.

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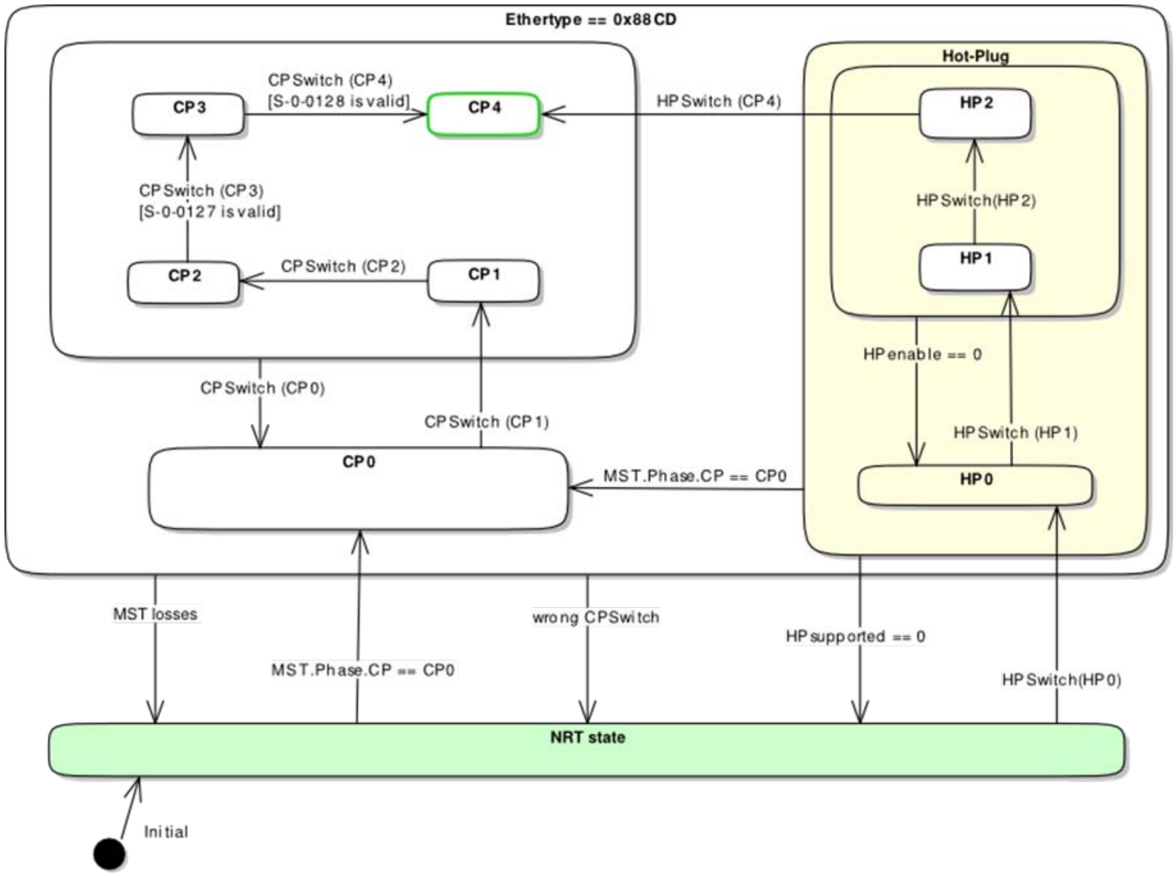

Figure 7 – Communication phase (CP) state machine

5.2.2.2 States of the CP state machine

5.2.2.2.1 General

The states of the CP state machine are described in Clauses 5.2.2.2.2 (NRT state), 5.2.2.2.3 (CP0), 5.2.2.2.4 (CP1), 5.2.2.2.5 (CP2), 5.2.2.2.6 (CP3) and 5.2.2.2.7 (CP4). The LED pattern shall be adjusted to the corresponding communication states.

5.2.2.2.2 Non-real-time state (NRT)

Upon powering on, the master and each slave shall activate NRT state independently.

NRT mode is activated during NRT state.

The collision buffer shall be administrated as described in the topology state machine.

The master shall leave NRT state to CP0 upon request by its DL user.

The slave shall check the MST of the type 19 telegrams. If the slave recognizes a MST with CP = 0, then it shall activate CP0 and change the topology. If a slave recognizes a MST with CP = 4, then it shall activate HP0, if hot-plug is supported.

Before entering NRT state from a state different to CP0 or HP0 the slave shall generate a link down on both ports.

In NRT state the slave may activate pattern #1 of Type 19 LED.

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5.2.2.2.3 Communication phase 0 (CP0)

During CP0, the master shall send MDT0 and AT0 as specified on one or both of its ports, depending on the given topology, in order to

- check the topology (for example check if the network is established);
- check if all slaves required by the application are present in the network.

The slave shall

- check the communication version;
- support the address allocation;
- change the topology state depending on the received MST automatically at time T7cp0 between
  – NRT state (store&forward or cut-through),
  – RT state (loopback with forward and fast-forward).

5.2.2.2.4 Communication phase 1 (CP1)

The topology indices which are determined in CP0 are used for the addressing of the service channels in CP1.

In CP1, the master shall initialize the service channels of all identified slaves of CP0.

During the request procedure the master shall send MDT0 and MDT1 (additional MDT2 and MDT3, if more than 255 slaves are identified) and set MHS=1 in the SVC control to request each used slave to insert data into the corresponding AT. AT0 and AT1 (additional AT2 and AT3, if more than 255 slaves are identified) shall be transmitted by the master with an allocated AT data field (contents are 0).

In the device control, the master shall adjust the following bits and all identified slaves shall evaluate them:

- C-DEV.identification
- C-DEV.topology
- C-DEV.status physical topology, only if UC channel is supported

If the C.DEV.Master valid = 1 in CP1, then the slaves shall evaluate the C-DEV in CP2 to CP4 only if C-DEV.Master valid is set to 1. If the C-DEV.Master valid = 0 in CP1, then this bit is not supported by the master and the slave shall evaluate the C-DEV in CP2 to CP4 also if the C-DEV.Master valid is set to 0.

During the request procedure the following sequence shall be handled by the master and all identified slaves.

a) At first the slave shall set Slave valid = 1 in the device status to indicate the availability in the topology.
b) If the slave is ready to communicate via SVC, then it shall set SVC valid = 1 into the corresponding SVC status.
c) Thereafter, the master shall set the MHS = 1 in the corresponding SVC control.
d) If a slave responds with AHS=1 in the SVC status within the handshake timeout (10 communication cycles), then the SVC is correct initialized.
e) If a slave does not respond with AHS=1 in the SVC status within the handshake timeout, then the master shall generate an error message and switches to CP0.

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In the device status, the slave shall adjust the following bits and the master shall evaluate them, if S-DEV.Slave valid = 1:

- S-DEV.Slave valid=1
- S-DEV.topology
- S-DEV.parameterization level
- S-DEV.communication warning interface
- S-DEV.C1D error of device
- S-DEV.C2D warning of device

All identified slaves shall behave as described here, even those with Sub-device (S-0-1040) address = 0.

5.2.2.2.5 Communication phase 2 (CP2)

During CP2, the slaves shall be addressed specifically using their corresponding service channel. For CP2 and higher phases, they shall support complete service channel functionality.

As a minimum, the master shall transmit to all present slaves:

- the communication parameters required for CP3 and CP4;
- the length of all MDTs and ATs;
- the offsets of their service channel and real-time data.

In the device control (C-DEV), the master shall adjust the following bits and all present slaves shall evaluate them, if C-DEV.Master valid is equal to CP1:

- C-DEV.Master valid = C-DEV.Master valid of CP1
- C-DEV.Identification
- C-DEV.Topology
- C-DEV.Status physical topology, only if UC channel is supported

In the device status, the slave shall adjust the following bits and the master shall evaluate them, if Slave valid = 1:

- S-DEV.Slave valid=1
- S-DEV.Topology
- S-DEV.Parameterization level
- S-DEV.Communication warning interface
- S-DEV.C1D error in device
- S-DEV.C2D warning in device
- S-DEV.procedure command change bit

The entire information exchange takes place via the mechanisms of the service channel (see 6.2). The reliability of transmission shall be guaranteed by the MHS and AHS bits as well as the HS timeout. Further parameter exchanges can take place in CP2 or CP3.

The master shall transmit the ring delays and activate S-0-1024 SYNC delay measuring procedure command of all slaves, which shall be synchronized. The slaves shall adjust the synchronization time depending on the ring delays.

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If the master sets t6 = 0 the UC channel is deactivated in CP3 and CP4, and the time t7 is don't care.

The transition from CP2 to CP3 shall be prepared according to the following procedure:

a) The master shall activate the procedure command S-0-0127 CP3 transition check as defined.
b) The slave shall then determine the validity of the parameters for CP3. The validity check of the parameters by the slave shall refer only to general criteria (e.g., minimum, maximum). It shall not recognize if all parameters that have been transmitted by the master are correct with respect to the master real-time data and the total installation. This means that even if a slave acknowledges the "CP3 transition check" positively, there can be incorrect communication parameters with respect to the total installation which can lead to a disruption of the communication.
c) If the slave detects any error, then it shall continue the process with the "Procedure with error". If there are additional invalid parameters still present after the procedure command has been processed, the slave shall
   - save the IDNs of the invalid data into the S-0-0021 IDN-list of invalid operation data for CP2 and shall
   - respond with the procedure command acknowledgment: "Error, procedure command execution impossible".

   After the negative procedure command acknowledgment,

   - the master may read the diagnostic parameters (e.g. S-0-0021, S-0-0390 Diagnostic number ...) and display an error message.
   - Before the master activates the S-0-0127 CP3 transition check again, it shall delete this procedure command in the slave.
   - In this faulty case, the master shall remain in CP2 and depending on its capabilities, try again to set the parameters identified as invalid or send an error message to allow further initialization by means of an operator intervention.

   After the master has written further parameters which are write protected in CP3 according to their attribute, the procedure command S-0-0127 CP3 transition check shall be activated once more.

d) If the slave does not detect any error, then it shall continue the process with the "Procedure without error".
   - The slave shall acknowledge the procedure command positively (e.g., "Procedure command executed correctly") and set CPS ready = 1.
   - After receiving the positive procedure command acknowledgment, the master shall delete the procedure command in the slave.
   - At parameters with variable length which can be configured also as application data, the current length indicator shall not be changed any more.
   - If the master has written further parameter which are write protected in CP3, after the positive procedure command acknowledgment, then the slave shall set CPS ready = 0 and the master shall repeat the procedure command S-0-0127 CP3 transition check again.
   - Otherwise, the master may then initiate the switching to CP3 (see 5.2.3).

5.2.2.2.6 Communication phase 3 (CP3)

Starting with CP3, the exchange of real-time data shall be done via the telegrams defined for CP4. The master shall send the configured MDTs and ATs to all slaves.

To support the IP switch, the master shall transmit the time slot parameters of the UC channel with broadcast address in the MDT HP field. Directly after the start of CP3 and immediately

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after ring recovery the master shall transmit t6 and t7 with the defined scan cycles of each parameter. The contents of the MDT HP field are shown in Table 52.

Table 52 – MDT hot-plug field in CP3 and after ring recovery

Sub-device address	HP control	MDT HP INFO	Scan cycles of each parameter
4095 (broadcast)	0x02 (coding of t6)	value of t6 (beginning of UC channel)	tScyc ≤ 2ms --> scan cycles = (2ms/tScyc) * 10 cycles tScyc > 2ms --> scan cycles = 10 cycles
4095 (broadcast)	0x03 (coding of t7)	value of t7 (end of UC channel)	tScyc ≤ 2ms --> scan cycles = (2ms/tScyc) * 10 cycles tScyc > 2ms --> scan cycles = 10 cycles

During CP3, the master may transmit application parameters (for example: Limits, thresholds, machinery parameter, etc.) for the slaves via the service channel. Transmission reliability for the service channel shall be guaranteed by the SVC control, SVC status and the HS timeout.

In CP3, the function specific profile may be activated.

The transition from CP3 to CP4 shall be performed according to the following procedure:

a) The master shall activate the procedure command S-0-0128 CP4 transition check as defined.

b) The slave shall then determine the validity of the parameters for CP4.

c) Afterwards, the slave shall complete the processing of the parameters that are required for operating the slave.

d) The slave shall then activate the synchronization.

e) If the slave detects any error, then it shall continue the process with the “Procedure with error”. If there are additional invalid parameters still present after the procedure command has been processed, the slave shall

   - save the IDNs of the invalid data into the S-0-0022 IDN-list of invalid operation data for CP3 and shall
   - respond with the procedure command acknowledgment: “Error, procedure command execution impossible”.

   After the negative procedure command acknowledgment,

   - the master may read the diagnostic parameters (e.g. S-0-0022, S-0-0390 Diagnostic number ...) and display an error message.
   - Before the master activates the S-0-0128 CP4 transition check again, it shall delete this procedure command in the slave.
   - In this faulty case, the master shall remain in CP3 and, depending on the capabilities of the master, try to re-establish the parameters identified as invalid or send an error message indicating that human intervention (e.g., operator) is required.

   After the master has written further parameters (depending on S-0-0022 IDN-list of invalid operation data for CP3) in the slave during CP3, the procedure command S-0-0128 CP4 transition check shall be activated once more.

f) If the slave does not detect any error, then it shall continue the process with the “Procedure without error”.

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- The slave shall acknowledge the procedure command positively (e.g., “procedure command executed correctly”) and set CPS ready = 1.
- After receiving the positive procedure command acknowledgment, the master shall delete the procedure command in the slave.
- If the master has written further parameter which are write protected in CP4, after the positive procedure command acknowledgment, then the slave shall set CPS ready = 0 and the master shall repeat the procedure command S-0-0128 CP4 transition check again.
- Otherwise, the master may then initiate the switching to CP4 (see 5.2.3).

5.2.2.2.7 Communication phase 4 (CP4)

Upon switching to CP4, the initialization is complete. In CP4 the master may enable all slaves and the application is ready to operate. The master shall send the configured MDTs and ATs to all slaves. The exchange of valid real-time data shall be done via the prepared connections defined for CP4.

The hot-plug function is activated in the master, if supported.

Transmission reliability for the service channel shall be guaranteed by the SVC control, SVC status and the HS timeout.

5.2.2.3 Transitions of CP state machine

Table 53 describes the transitions of the CP state machine.

Table 53 – Transitions of CP state machine

Transition		Condition	Description
Source	**Target**		
NRT state	CP0	MST.Phase.CP=CP0	The master shall leave NRT state to CP0 upon request by its DL user. In this case the master shall transmit MST with CP0. If the slave receives a MST (MDT0) with CP0 while it is in NRT state the slave shall activate CP0 as well as the Loopback with forward at the port at which the slave has received the MST.
Ethertype = 0x88CD	NRT state	MST losses	During CP0, CP1 or CP2: If a slave does not receive any MST in CP0, CP1 or CP2 within the MST timeout (130ms), then it shall switch to NRT state. During CP3 or CP4: If the maximum number of MST losses (communication error) exceeds the S-0-1003 Allowed MST losses in CP3&CP4, then the slave switches to NRT state. Before entering NRT state from a state different to CP0 or HP0 the slave shall generate a link down on both ports.
Ethertype = 0x88CD	NRT state	wrong CPSwitch	If an error occurs during phase switching, then - the slave switches to NRT state. - the master switches to CP0. Detailed description see 5.2.3. Before entering NRT state from a state different to CP0 or HP0 the slave shall generate a link down on both ports.
CP0	CP1	CPSwitch(CP1)	As soon as the master has received at least 100 AT0 with the same content of sequence counter and the number of modified topology index fields corresponds to the SEQCNT according to the

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Transition		Condition	Description
Source	Target		
			given topology and all recommended slaves are present, the master may initiate to switch to CP1. The address allocation shall be canceled in the slave if it recognizes MST.Phase.CPS = 1.
CP1	CP2	CPSwitch(CP2)	After the master has initialized the service channel of all slaves on the Type 19 network, the master shall switch to CP2 (see 5.2.3). If the initialization time of the service channels is exceeded, then master may respond with an error message depending upon configuration and switch to CP0.
CP2	CP3	CPSwitch(CP3)	The transition from CP2 to CP3 shall be performed only if the checks of S-0-0127 CP3 transition check have passed successfully.
CP3	CP4	CPSwitch(CP4)	The transition from CP3 to CP4 shall be performed only if the checks of S-0-0128 CP4 transition check have passed successfully.
CP1-CP4	CP0	CPSwitch(CP0)	The only possibility of leaving the Communication phases CP1 to CP4 (other than up-shift phases) shall be a return to CP0. The reason for this can be operator intervention. Any slave which recognizes CP0 shall shut-down itself in the best possible manner. The method of shutting down the slaves is part of the function specific profiles.

NOTE Details about the CPSwitch(CPx) are described in the corresponding state machine.

5.2.3 Switching of communication phases (CPS)

5.2.3.1 Sequence of CP switching in the master

Figure 8 describes the CPS state machine of a master. The LED pattern shall be adjusted to the corresponding topology state.

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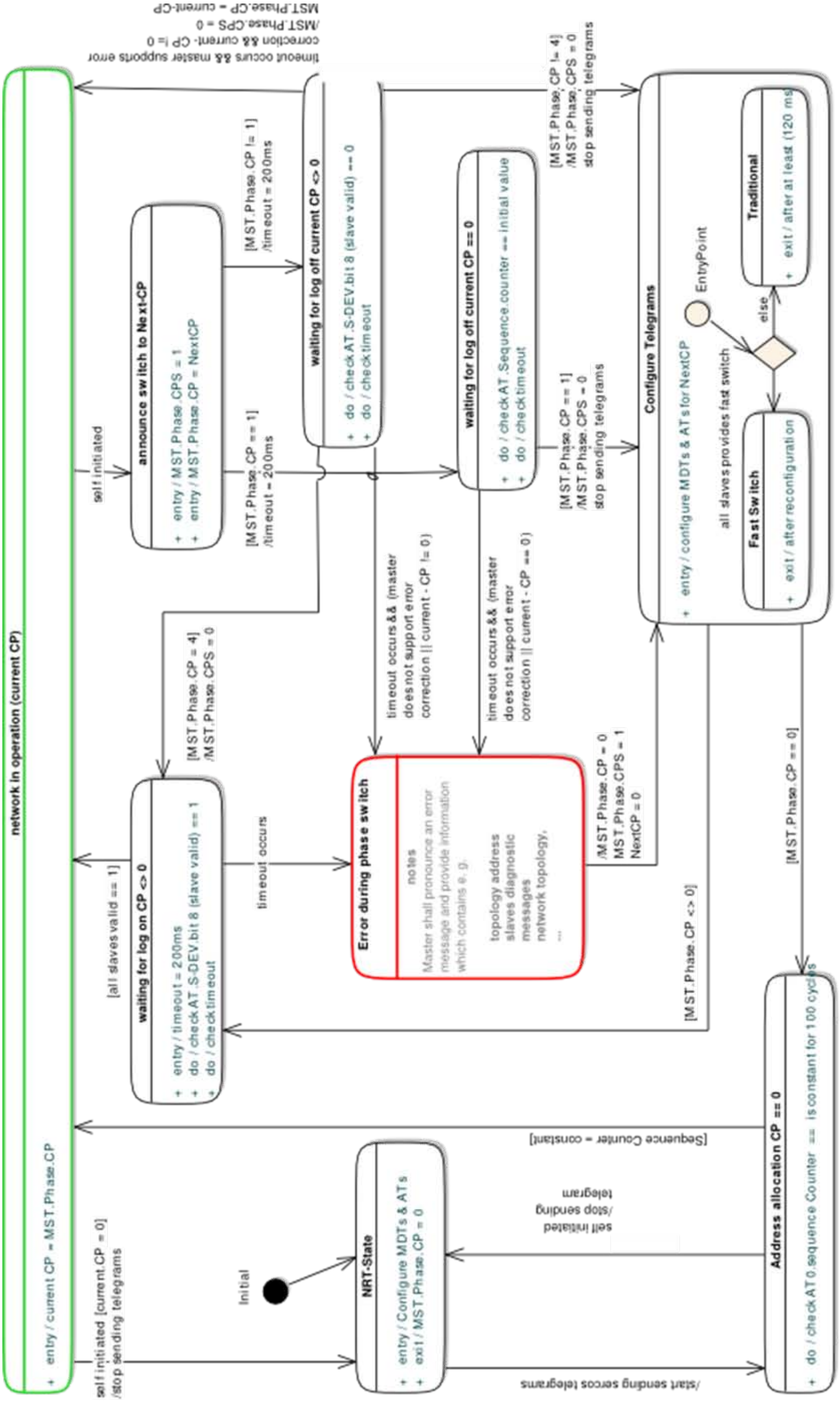

Figure 8 – CPSwitch state machine master

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NOTES

- current CP = at the time active CP
- next CP = CP0 or current CP or current CP + 1 (only valid, if current CP < 4)
- CPS master timeout = 200 ms
- CPS delay time = 120 ms
- SEQCNT = sequence counter in AT0 of CP0

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5.2.3.2 States of CPSwitch state machine of the master

The states of the state machine are described in Table 54.

Table 54 – States of master CPSwitch state machine

State	Description
NRT state	Upon powering on, the master and each slave shall activate NRT state independently. NRT mode is activated during NRT state. The collision buffer shall be administrated as described in the topology state machine. The master shall leave NRT state to CP0 upon request by its DL user. The slave shall check the MST of the Type 19 telegrams. If the slave recognizes a • MST with CP = 0, then it shall activate CP0 and change the topology (see 5.3.6) • MST with CP = 4, then it shall activate HP0, if hot-plug is supported. Before entering NRT state from a state different to CP0 or HP0 the slave shall generate a link down on both ports. In NRT state the slave may activate pattern #1 of Type 19 LED.
Address allocation CP == 0	The master shall set the CPS master timeout (200 ms) and waits until the received SEQCNT of AT0 is constant. The master shall check the received sequence counter (SEQCNT) of AT0. If the sequence counter is not changed within 100 successive communication cycles, then the master may switch to "network in operation".
waiting for log on CP ≠ 0	The master shall set the CPS master timeout (200 ms) and waits until all slave valid bits are set to 1. In CP1 to CP4 the master shall check the slave valid bit. If the slave valid bit is set to 1 by each slave, then the master switches to "network in operation".
Network in operation (current CP)	The master transmit MDTs and ATs with the timing of the current CP.
Announce switch to next CP	In order to switch the communication phase, the master shall set the condition in the MST (CPS = 1 and next CP). The master shall determine the next CP, see notes.
Waiting for log off current CP == 0	The master shall set the CPS Master timeout (200 ms) and waits until the received SEQCNT is equal to the transmitted SEQCNT (initial value of transmitted SEQCNT = 1). In CP0 (MST.Phase.CPS = 1 && MST.Phase.CP = 1) the master checks the received sequence counter of AT0. If the sequence counter is not changed by any slave, then the master switches to "Configure telegrams".
Waiting for log off current CP ≠ 0	The master shall set the CPS Master timeout (200 ms) and waits until the slaves do not set the slave valid to 1. As long as any slave sets the slave valid to 1 the master remains in this state and shall transmit MDTs and ATs. In CP1 to CP4 (MST.Phase.CP ≠ 1 && MST.Phase.CPS = 1) the master shall check the slave valid bit. If the slave valid bit is set to 0 by each slave, then the master switches to "Configure telegrams".
Configure telegrams	The master shall stop the transmission of MDTs and ATs. The master shall configure the MDTs, ATs and the timing for the next CP. If all slaves on the network supports the CPS switching without CPS delay time, then the master activates the state "Fast switch". Otherwise the master shall activate the state "Traditional".
Fast switch	The master switches to the announced state immediately (CPS delay time = 0ms).
Traditional	The master waits the CPS delay time (120ms) and then it switches to the announced state.
Error during phase switch	The master shall generate an error message, which may contain one of the following items e.g. • device address • topology index • slave diagnostics • network diagnostics • and switches to CP0.

5.2.3.3 Transitions of CPSwitch state machine of the master

The transitions of the state machine are described in Table 55.

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Table 55 – Transitions of master CPSwitch state machine

Transition			Description
Source	Target	Condition	
NRT state	Address allocation CP == 0	Start sending Type 19 telegrams	The master leaves the NRT state and switches to CP0 by sending MST with CP0.
Network in Operation	NRT state	self initiated current CP = 0 stop sending telegrams	The master shall only switch from CP0 to NRT state by transmitting no more Type 19 telegrams.
Address allocation CP == 0	Network in operation	SEQCNT = constant	If the sequence counter is constant for 100 cycles, then the next CP (CP1) maybe activated by the master and the address allocation is finished.
Address allocation CP == 0	NRT state	self initiated stop sending telegrams	If the master does not recognize a constant SEQCNT within 100 cycles, then the check is repeated up to 10 times. If no constant result is achieved during this time, then the Master generates an error message and switches to NRT state.
Network in operation	Announce switch to next CP	Self initiated	If the master would like to change the communication phase, then it activates the state "Announce switch to next CP". The master shall set CPS = 1 and the MST.Phase.CP to next CP (see notes).
Announce switch to next CP	Waiting for log off, current CP = 0	MST.Phase.CP = 1 CPS master timeout = 200ms	After the master has announced the next CP with CP1, the master sets the CPS master timeout and activates the state "Waiting for log off, current CP = 0".
Announce switch to next CP	Waiting for log off, current CP ≠ 0	MST.Phase.CP ≠ 1 CPS master timeout = 200ms	After the master has announced the next CP with CP ≠ 1, the master sets the CPS master timeout and activates the state "Waiting for log off, current CP ≠ 0".
Waiting for log off, current CP = 0	Configure telegrams	MST.Phase.CP = 1, CPS = 0 Stop sending telegrams	If the sequence counter is not changed by any slave in CP0, the master stops the transmission of MDTs and ATs, activates the state "Configure telegrams" and prepares the next CP.
Waiting for log off, current CP ≠ 0	Configure telegrams	MST.Phase.CP ≠ 4, CPS = 0 Stop sending telegrams	If slave valid = 0 of all slaves in CP1 to CP3, the master stops the transmission of MDTs and ATs, activates the state "Configure telegrams" and prepares the next CP.
Waiting for log off, current CP ≠ 0	waiting for log on, CP ≠ 0	MST.Phase.CP = 4, CPS = 0	If switching from CP3 to CP4 the master does not stop transmitting MDTs and ATs because the structure of the Type 19 telegrams and the timing are identical.
Configure telegrams	Waiting for log on, current CP ≠ 0	MST.Phase.CP ≠ 0	After the Type 19 telegrams are configured for the next CP (CP1 to CP3) and the CPS delay time occurs the master shall transmit the Type 19 telegrams with the structure and timing of the next CP.
Configure telegrams	Address allocation CP = 0	MST.Phase.CP = 0	After the Type 19 telegrams are configured for CP0 and the CPS delay time occurs the master shall transmit the Type 19 telegrams with the structure and timing of CP0.
Waiting for log on, current CP ≠ 0	Network in operation	slave valid = 1 of all slaves	If slave valid = 1 of all slaves, then the next CP (CP0, CP2 to CP4) maybe activate by the master.
Waiting for log off, current CP ≠ 0	network in operation	CPS master timeout occurs and master supports error correction	If the current CP ≠ 0, the master activates the current CP again by setting the MST.Phase.CP = current CP and CPS = 0. Now the master can check why not have one or more slaves logged off. If the cause of the error can be fixed, the phase switching shall continue, if it cannot be fixed, the master shall

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Transition			Description
Source	Target	Condition	
			switch to CP0.
Errors during phase switching			
waiting for log on, CP ≠ 0	Error during phase switch	CPS master timeout occurs	After the CPS master timeout is exceeded in CP1 to CP4 and the master did not receive the slave valid = 1 of each slave, then the master shall produce an error message showing e.g. the respective device addresses and topology indices. After deleting the error by the control unit, the master shall switch to CP0.
Waiting for log off, current CP = 0	Error during phase switch	CPS master timeout occurs and master does not support error correction	After the CPS master timeout is exceeded in CP0 and the master still receives a changed SEQCNT in AT0, then the master shall produce an error message showing e.g. the respective device addresses and topology indices. After deleting the error by the control unit, the master shall switch to CP0.
Waiting for log off, current CP ≠ 0	Error during phase switch	CPS master timeout occurs and master does not support error correction	After the CPS master timeout is exceeded in CP1 to CP4 and the master still receives slave valid = 1 of one or more slaves, then the master shall produce an error message showing e.g. the respective device addresses and topology indices. After deleting the error by the control unit, the master shall switch to CP0.
Error during phase switch	Configure telegrams	Next CP = 0	The master leaves the error state by setting the MST.Phase.CP = 0 and MST.Phase.CPS = 1. The master switches to CP0 via "configure telegrams".

5.2.3.4 Sequence of CP switching in the slave

Figure 9 shows the CPSwitch state machine of the slave.

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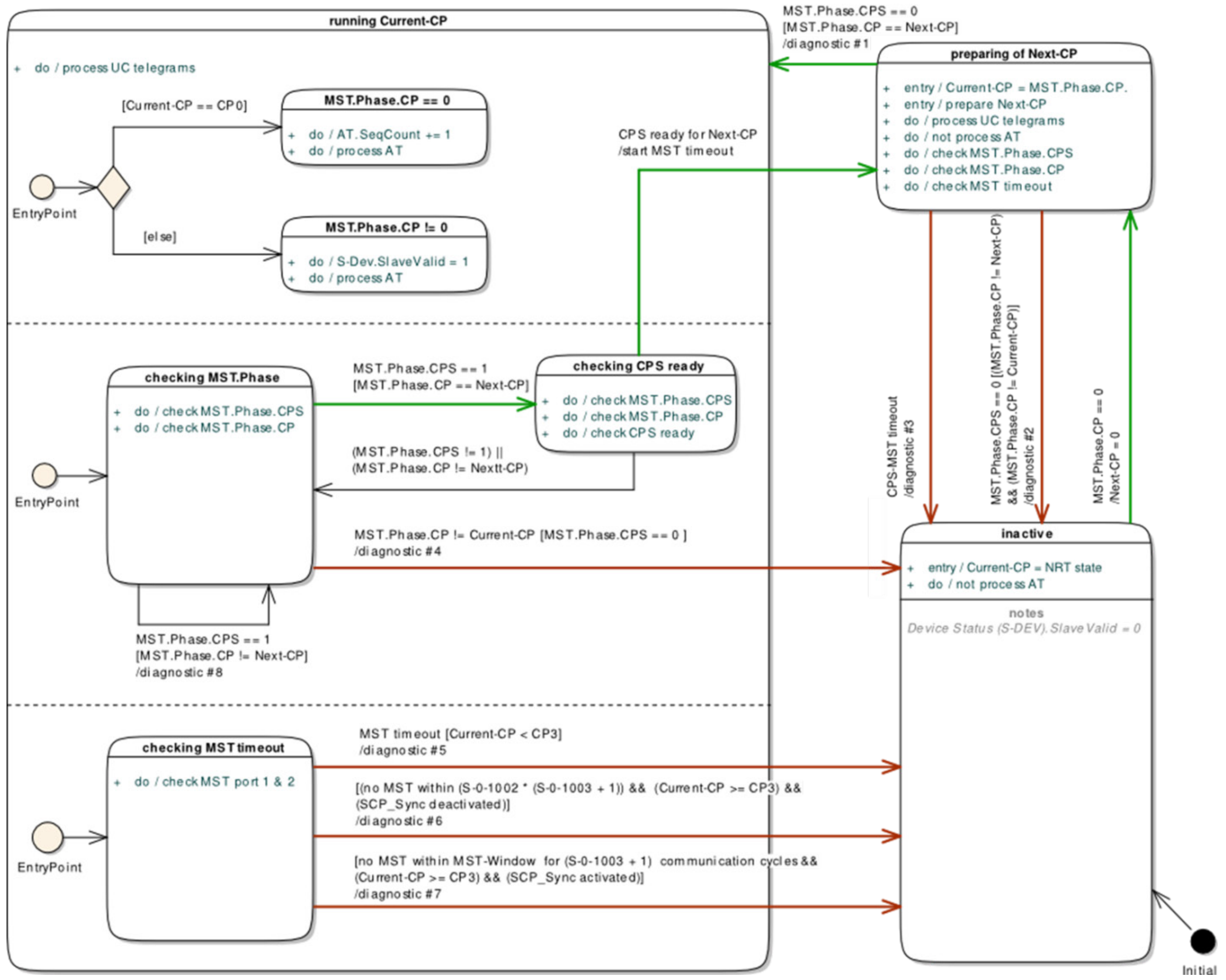

Figure 9 – CPSwitch state machine of the slave

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NOTES

- current CP = at the time active CP
- next CP = CP0 or Current-CP or Current-CP + 1 (only valid, if current CP < 4)
- SEQCNT = sequence counter in AT0 of CP0
- CPS-MST timeout = 500ms
- MST timeout = 130ms

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5.2.3.5 States of CP switching in the slave

Table 56 shows the states of the CPSwitch state machine.

Table 56 – States of slave CPSwitch state machine

State	Description
running Current-CP	This state contains the following states that are processed simultaneously: • MST.Phase.CP == 0 • MST.Phase.CP != 0 • checking MST.Phase • checking MST timeout • checking CPS ready The slave shall process UC telegrams.
MST.Phase.CP == 0	The slave activates CP0 and shall evaluate the Communication Version in the MDT0 of CP0 and shall activate the Address allocation.
MST.Phase.CP != 0	Depending on Current-CP the slave activates CP1, CP2, CP3 or CP4. The slave shall set S-DEV.SlaveValid to 1 and shall process MDT and AT as defined in the corresponding communication phase.
checking MST.Phase	The slave shall recognize the phase switching in the MST with CPS = 1 and Next-CP. • Next-CP shall be equal to • Current-CP + 1 (valid only, if Current-CP < 4) or • CP0.
checking MST timeout	The slave shall check the MST on both ports related to the CP.
checking CPS ready	If the slave recognizes the following conditions • MST.Phase.CPS is 1 and • MST.Phase.CP is Next-CP and the • CP related procedure command has been finished positively (CP2 and CP3 only) and • SVC valid is 1, then the slave generates "CPS ready for Next-CP" by setting slave valid to 0.
preparing of Next-CP	The slave shall not write data to the ATs any more. The slave writes the MST.Phase.CP to Current-CP. The slave prepares the Next-CP internally and activates the CPS MST timeout. This watchdog is triggered with every received MST. The slave shall wait to a MST with MST.Phase.CPS is 0 and MST.Phase.CP is Next-CP. The slave shall process the UC telegrams.
inactive	The slave shall set Slave valid = 0 and shall not write data to the ATs any more. The slave shall activate NRT state and shall process UC telegrams. Before entering NRT state from a state different to CP0 or HP0 the slave shall generate a link down on both ports.

5.2.3.6 Transitions of CP switching in the slave

The transitions of the state machine are shown in Table 57, Table 58 and Table 59.

Table 57 – Transitions of slave CPSwitch state machine

Transition with warning			Description
Source	Target	Condition	
Inactive	preparing of Next-CP	MST.Phase.CP == 0	Next CP = 0, slave switches to CP0
preparing of Next-CP	running Current-CP	MST.Phase.CPS == 0 &&	The master finished the phase switching correctly. The slave generates diagnostic #1 and

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Transition with warning			Description
Source	Target	Condition	
		MST.Phase.CP == Next CP	activates the state "running Current-CP".
running Current-CP	MST.Phase.CP == 0	Current-CP == 0	The slave switches to CP0.
running Current-CP	MST.Phase.CP != 0	Current-CP != 0	Depending on Current-CP the slave switches to CP1, CP2, CP3 or CP4.
checking MST.Phase	checking CPS ready	MST.Phase.CPS == 1 && MST.Phase.CP == Next-CP	The master announces the next CP with CPS = 1 correctly. The slave activates the state "checking CPS ready".
checking CPS ready	checking MST.Phase	MST.Phase.CPS != 0 or MST.Phase.CP != Next-CP	If the slave detects a change in the MST.Phase.CPS or in the MST.Phase.CP, then it shall return to state "checking MST.Phase". **Recommended:** The master should move back the slave with the condition MST.Phase.CPS = 0 && MST.Phase.CP = Current-CP, in order to generate no error. The master may check the diagnostics of the slave to see why it has not set the CPS ready for Next-CP.
checking CPS ready	preparing of Next-CP	CPS ready for Next-CP	If the slave determines CPS ready for Next-CP, then it shall set the Slave valid to 0 and activate the state "preparing of Next-CP".

Table 58 – Transitions of slave CPSwitch state machine (transitions with warning)

Transition with warning			Description
Source	Target	Condition	
checking MST.Phase	checking MST.Phase	MST.Phase.CPS == 1 && MST.Phase.CP != Next CP	The master announces the Next-CP with CPS = 1 incorrectly, that means the Next-CP is not Current-CP or Current-CP+1 (vaild only, if Current-CP < 4) or CP0. In this case the slave generates diagnostic #8 and remains in the same state.

Table 59 – Transitions of slave CPSwitch state machine (transitions with error)

Transition with error			Description
Source	Target	Condition	
checking MST.Phase	inactive	MST.Phase.CPS == 0 && MST.Phase.CP != Current CP	The Master changes the phase without CPS = 1. The slave generates diagnostic #4 and activates state "inactive".
checking MST timeout	inactive	MST timeout && Current CP < CP3	MST timeout in CP0 to CP2: The slave does not receive a MST within the MST timeout (**130ms**). The slave generates diagnostic #5 and activates state "inactive".
checking MST timeout	inactive	no MST within (S-0-1002 * (S-0-1003 + 1)) && (Current CP ≥ CP3) && (SCP_Sync deactivated)	MST losses in CP3 and CP4 without SCP_Sync: The slave without SCP_Sync does not receive a MST within the MST timeout defined by S-0-1002 Communication Cycle time (tScyc) and S-0-1003 Allowed MST losses in CP3&CP4. MST timeout = tScyc * (allowed MST losses + 1). The slave generates diagnostic #6 and activates state "inactive".

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Transition with error			Description
Source	Target	Condition	
checking MST timeout	inactive	no MST within MST Window for (S-0-1003 + 1) communication cycles && (Current CP ≥ CP3) && (SCP_Sync activated)	MST losses in CP3 and CP4 with SCP_Sync: The slave with SCP_Sync recognizes more successive MST losses as defined by the S-0-1003 Allowed MST losses in CP3&CP4 (allowed MST losses + 1). The slave generates diagnostic #7 and activates state "inactive".
preparing of Next-CP	Inactive	CPS-MST timeout (500ms)	If the CPS-MST timeout occurs, then the slave generates diagnostic #3 and activates state "inactive".
preparing of Next-CP	Inactive	MST.Phase.CPS == 0 && (MST.Phase.CP != Next CP) && (MST.Phase.CP != Current-CP)	During phase switching is in process the master changes the phase to an invalid CP. The slave generates diagnostic #2 and activates state "inactive".

5.2.3.7 Diagnosis of the CPS state machine

During the CPS transitions the slave generates the diagnostics shown in Table 60.

Table 60 – Diagnostics of CPS state machine slave

Diagnostic	Device status	Pattern of LED	S-0-0390	S-0-0014	Description
#1	Bit 7 = 0 Bit 6 = 0	MST.Phase.CP	---	Bit 2..0 = MST.Phase.CP	Switching of communication phase finished without error
#2 (to be used in new implementations of Type 19 devices)	Bit 7 = 1	Communication error	0xC30F4019	Bit 13 = 1	• During phase switching the master sets MST.Phase.CPS = 0 and MST.Phase.CP is set to one of the following invalid conditions: • MST.Phase.CP > 4, invalid CP • MST.Phase.CP ≠ current CP + 1, invalid sequence during the phase upshift. • MST.Phase.CP ≠ CP0, invalid sequence during the phase downshift.
#2a (used until V1.1.2 of CP16/3)	Bit 7 = 1	Communication error	0xC30F4003	Bit 5 = 1	During phase switching the master sets MST.Phase.CPS = 0 and MST.Phase.CP > 4, invalid CP.
#2b (used until V1.1.2 of CP16/3)	Bit 7 = 1	Communication error	0xC30F4004	Bit 6 = 1	During phase switching the master sets MST.Phase.CPS = 0 and MST.Phase.CP ≠ current CP + 1, invalid sequence during the phase upshift.
#2c (used until V1.1.2 of CP16/3)	Bit 7 = 1	Communication error	0xC30F4005	Bit 7 = 1	During phase switching the master sets MST.Phase.CPS = 0 and MST.Phase.CP ≠ CP0, invalid sequence during the phase downshift.
#3	Bit 7 = 1	Communication error	0xC30F4017	Bit 12 = 1	During phase switching is active the master did not send the MSTs again and the CPS-MST timeout occurs in the slave.
#4 (to be used in new implementations of Type	Bit 7 = 1	Communication error	0xC30F4019	Bit 13 = 1	• The master changes the MST.Phase.CP with MST.Phase.CPS = 0 and MST.Phase.CP is set to one of the following invalid conditions:

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Diagnostic	Device status	Pattern of LED	S-0-0390	S-0-0014	Description
19 devices)					• MST.Phase.CP > 4, invalid CP. • MST.Phase.CP ≠ current CP + 1, invalid sequence during the phase upshift. • MST.Phase.CP ≠ CP0, invalid sequence during the phase downshift.
#4a (used until V1.1.2 of CP16/3)	Bit 7 = 1	Communication error	0xC30F4003	Bit 5 = 1	The master changes the CP with MST.Phase.CPS = 0 and set MST.Phase.CP > 4, --> invalid CP.
#4b (used until V1.1.2 of CP16/3)	Bit 7 = 1	Communication error	0xC30F4004	Bit 6 = 1	The master changes the CP with MST.Phase.CPS = 0 and set MST.Phase.CP ≠ current CP + 1, --> invalid sequence during the phase upshift.
#4c (used until V1.1.2 of CP16/3)	Bit 7 = 1	Communication error	0xC30F4005	Bit 7 = 1	The master changes the CP with MST.Phase.CPS = 0 and set MST.Phase.CP ≠ CP0, --> invalid sequence during the phase downshift.
#4d (used until V1.1.2 of CP16/3)	Bit 7 = 1	Communication error	0xC30F4006	--	The master changes the current-CP with MST.Phase.CPS = 0.
#6	Bit 7 = 1	Communication error	0xC30F4001	Bit 3 = 1	In CP3 and CP4 the slave did not receive a MST within the time defined by S-0-1002 Communication Cycle time (tScyc) and S-0-1003 Allowed MST losses in CP3&CP4, [S-0-1002 * (S-0-1003 + 1)], SCP_Sync is deactivated.
#7	Bit 7 = 1	Communication error	0xC30F4001	Bit 3 = 1	In CP3 and CP4 the successive MST losses exceeds the value defined in S-0-1003 Allowed MST losses in CP3&CP4. SCP_Sync is activated.
#8	Bit 6 = 1	---	0xC30E4019	Bit 2..0 = current CP	The master changes the MST.Phase.CP with CPS = 1 and MST.Phase.CP is set to one of the following invalid conditions: MST.Phase.CP > 4, invalid CP. MST.Phase.CP ≠ current CP + 1, invalid sequence during the phase upshift. MST.Phase.CP ≠ CP0, invalid sequence during the phase downshift.
#5	---	NRT state	0xC30A0008	Bit 2..0 = 7 (-1)	MST timeout (130ms) occurs in CP0 to CP2, the slave shall switch to NRT state

5.2.4 Communication Version

The master transmits the communication version in the MDT0 of CP0. The communication version (see Table 9) defines functions used by the master in CP0 to CP2.

- The slave shall compare the received Communication version with its own.
- If no difference is detected, then the slave shall participate in CP0 and follows the requirements of the master.

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- If a difference is detected, then the slave shall check at first the "basis frame structure of AT0" (bits 7-0) and secondly the requested functions and add-ons of CP0 to CP2 (bits 31-8) as described below.

a) Communication Version bits 7-0
   1) If the slave detects no difference within bits 7-0, then the slave shall participate in CP0 and follows the requirements of the master.
   2) If the slave detects a difference within bits 7-0, then the slave does not know the structure of AT0 and may not communicate with the master.
      - The slave shall not participate in the Type 19 communication in CP0, that means it shall not insert data (e.g. its device address) in the AT0.
      - The slave may signal this on its Type 19 LED (pattern #13). In this case the phase up-shifting to CP1 is not possible.
      - Continue with Error reaction.

b) Communication Version bits 31-8
   1) All add-ons shall be supported by the slave.
   2) If the slave supports all requested functions, then the slave shall set bit 15 = 1 in the topology index of AT0-CP0.
   3) If the slave does not support all requested functions, then the slave
      - may signal this on its Type 19 LED (pattern #13),
      - shall process the address allocation in the AT0-CP0 and
      - shall set bit 15 = 0 of the topology index in AT0-CP0.
      - In this case the phase up-shifting to CP1 is not possible.

c) Error reaction
   1) If the master switches with the announced communication version to CP1, then the slave shall set the S-0-0390 Diagnostic number to 0xC30F4021 and activates NRT state.
      - The master may identify the error and generates an error message shown on the display.
      - In this case the master shall activate CP0 again and shall announce a previous communication version, which is supported by all slaves. Otherwise the phase up-shifting is not possible.

5.2.5 Address allocation in the master and slave

The master and the slaves shall always support the address allocation.

The topology index determined by the address allocation is used to address the service channel in CP1 and CP2. Therefore a valid sub-device address is not necessary in CP0 to CP2.

The content of topology index in the AT0 of CP0 shall be as specified in Table 28.

Functional sequence with line, ring and interrupted ring:

- The master shall transmit the AT0 and set the content as specified in Table 27.
- The slave shall read and increment the content of sequence counter (SEQCNT) field in the AT0. The read sequence counter corresponds to the order of the slave in the topology, called topology index (TADR).
- Additionally the slave shall write its sub-device address into the corresponding topology index field. Slaves with sub-device address = 0 or sub-device address > 511 shall support CP0 in the same way as slaves with sub-device address 1 to 511.

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- The address allocation shall be done by the slave in CP0 at every passed AT0.
- Devices with multiple slaves increment the sequence count by one for each slave.
- Each slave receives two sequence counters (port 1 and port 2), the higher sequence counter is discarded.
- The slave will always mask the bit 15 of the valid sequence counter when determining its own topology address.

Further functional sequence with line only (see Figure 10):

- The last slave in line increments the sequence counter once.
- The master will always mask the bit 15 of the received sequence counter.
- For monitoring the master shall divide the sequence counter by 2 to get the number of slaves in the topology.

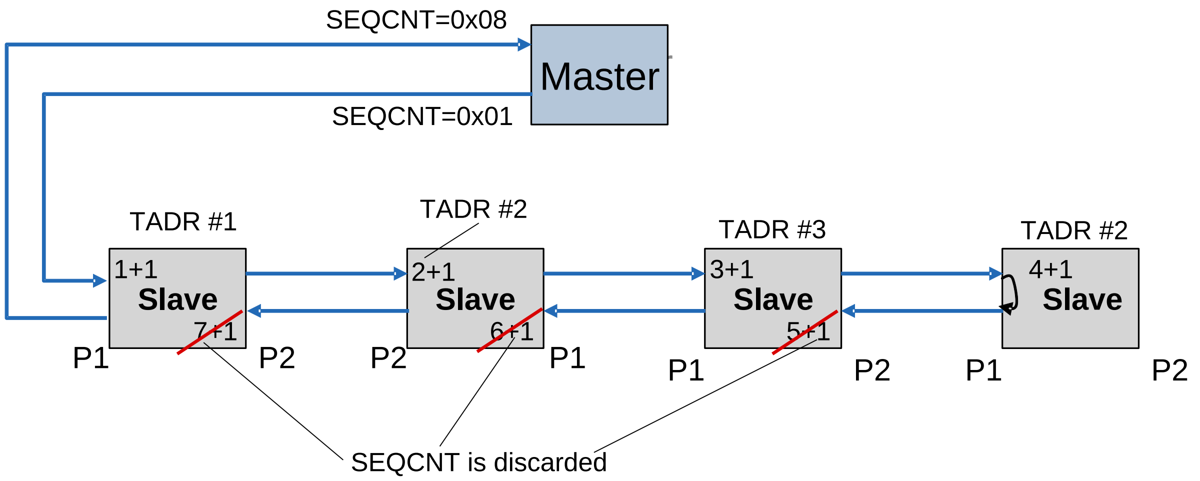

Figure 10 – Address allocation with line

Further functional sequence with ring only (see Figure 11):

- The master receives two sequence counters (port 1 and port 2), the higher sequence counter is discarded.
- For monitoring the master shall decrement the sequence counter by 1 to get the number of slaves in the topology.

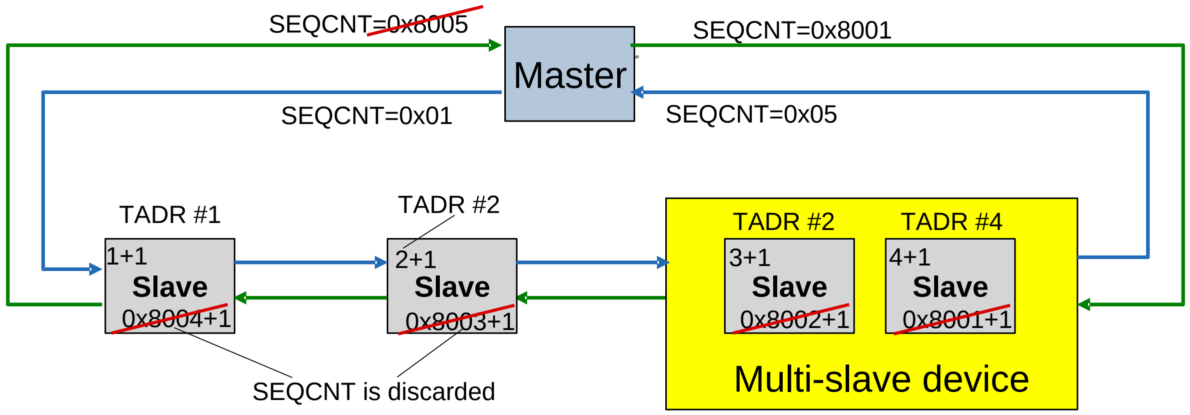

Figure 11 – Address allocation with ring

Further functional sequence with interrupted ring only (see Figure 12):

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- The last slave in line increments the sequence counter once.
- The master shall transmit the sequence counter with the value 0x01 on port x. The received sequence counter on port Px shall be modified and transmitted on port Py.
- Modification of sequence counter on port Py:

$$SEQCNT\_Py = \frac{received\ SEQCNT\_Px}{2} + 0x8001$$

- The master shall transmit the modified sequence counter on Port Py. It is necessary to get an unique topology address, because the SVCs are addressed by the topology index in CP1 and CP2.
- The master will always mask the bit 15 of both received sequence counters.
- The master shall list the device addresses of the line with the greater received SEQCNT in a reversed order in its address table (e.g. for diagnosis purposes with device address and topology index).
- If the master detects that the ring can be closed, then the master may close the ring in CP1 to CP4.

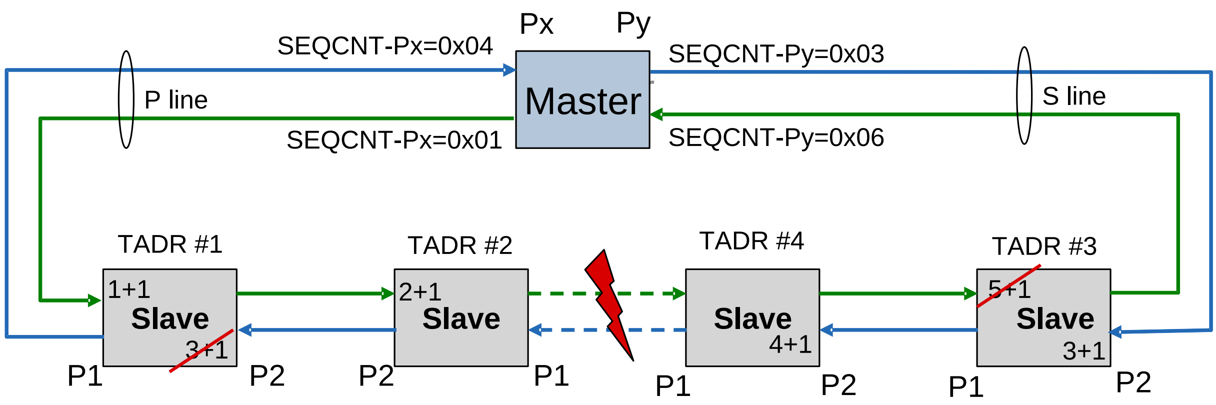

Figure 12 – Address allocation with interrupted ring

The master shall wait for its MDT0 and AT0 to be received. Depending on its configuration, the master may compare the detected device addresses with the device addresses that it is expecting to find, and then evaluate deviations (e.g., generate an error message).

If the procedure of the address allocation cannot be achieved within the time set by the master, the master shall remain in CP0 and generate a message. The scope of the message and at what point it has to be activated is a function of the master.

The master may generate the following 4 diagnostics in CP0:

- wrong device address: device address = 0 or greater than 511.
- same device address: master found several device addresses with the same value.
- not supported device address: device address is not supported by the master.
- unnecessary device address (waste slave): device address not necessary for the application.

5.3 Network topologies

5.3.1 Introduction

The physical network topology consists of full-duplex, point-to-point transmission lines and participants. The master and the slaves are parts of the Type 19 network and are its participants.

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Each slave has two communication ports (port 1 and port 2). Port 1 (P1) and port 2 (P2) shall be interchangeable.

The physical network topology shall be either a ring structure or a line structure. A ring shall have two logical channels (primary and secondary) and a line shall have only one logical channel (primary or secondary).

The difference between ring and line structure is that the ring has a built-in redundancy against transmission media faults (for example, cable break) and should therefore be preferred.

Each master handles only one network. In line topology, the master needs one port only. In ring topology, the master shall support two ports.

NOTE A control unit may have one or more master interfaces depending on the configuration.

Type 19 communication interfaces shall be used to connect the slaves to the Type 19 network. At the physical layer, a Type 19 communication interface represents the connection of one or more slaves to the Type 19 network. Logically, one Type 19 communication interface with several slaves shall act the same as several Type 19 communication interfaces with one slave each. Cyclic communication may take place between all Type 19 devices within a Type 19 network.

The physical arrangement of slaves in the network is independent from the predefined device addresses of the slaves, as well as from the sequence of the real-time data fields in the MDT and AT.

Any slave is able to recognize the topology at any time, using the difference between primary and secondary telegrams. This is important if a slave is added to the communication at a later point in time (for example, addition of new machine parts, hot-plug). If a slave receives telegrams with the same Type 19 type on both ports (MDT0-P or MDT0-S) it recognizes a line. If it receives a MDT0-P on one port and a MDT0-S on the other port, it recognizes a ring.

5.3.2 Ring topology

The ring topology shall consist of a primary and a secondary channel. All slaves work in fast-forward mode (see Figure 13). Redundancy to protect against cable fault (for example disconnection, undesired cable break) is achieved through this ring. It is possible to open the ring and insert or remove slaves during operation (hot-plug). In case of a cable break at port 1 the slave shall activate loopback with forward at port 2 and vice versa.

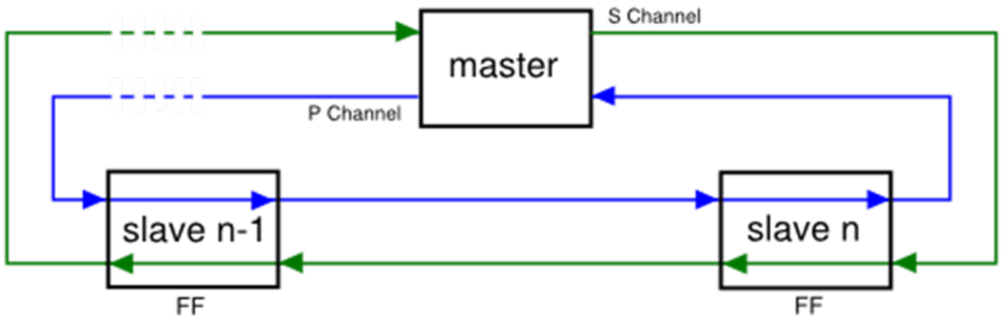

Figure 13 – Ring topology with P&S channel

5.3.3 Line topology

The line topology consists of either a primary or a secondary channel, depending upon configuration. The last physical slave performs the loopback with forward function. All other slaves work in fast-forward mode. It is possible to add or remove slaves at the end of the line

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during operation (hot-plug). In case of a cable break at one port the slave shall always activate loopback with forward at this port where it receives MST first (see Figure 14).

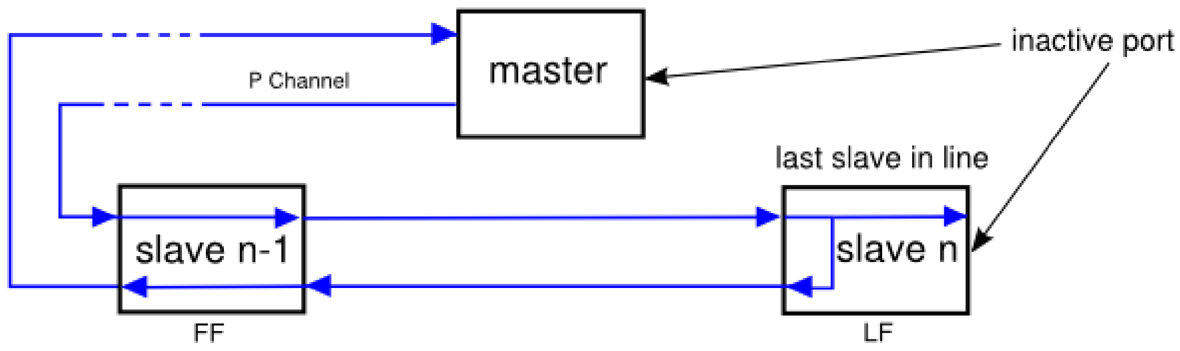

Figure 14 – Line topology with P channel (as example)

If no Ethernet device or no Type 19 device is connected or a ring break is present on the port, then this port is called inactive port. The inactive port

- shall receive any Ethernet-based telegrams.
- may support the insertion of a received non-Type 19 telegram into the Type 19 network.
- shall react on Type 19 telegrams and evaluate the MST.
- shall transmit UC telegrams as well as Type 19 telegrams.
- shall set the corresponding bits in device status to support ring recovery.
- shall use the Type 19 timing of the active port.

5.3.4 Topology conditions of a slave device

Each port of a slave shall be assigned to a processing unit and a multiplexer (see Figure 15). The functions in the slave shall depend on the topology and on the time slot within the communication cycle (RT channel or UC channel, see Figure 59).

The master has only a processing unit for each port (no multiplexing and no loopback).

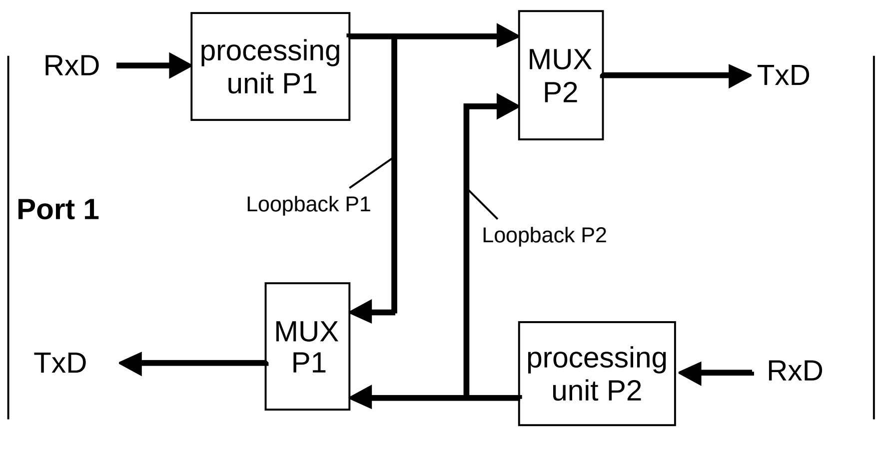

Figure 15 – Block diagram of a slave

- Case 1: During NRT state, a slave in NRT mode shall activate the loopback with forward on the port from where it received the first MST.

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- Case 2: During CP0, a slave in loopback with forward shall disable loopback and enable fast-forward after it receives MST on both ports.
- Case 3: During CP0, a slave in fast-forward shall activate loopback on one port after it does not receive any MST on the other port within the MST timeout (130 ms).
- Case 4: During CP0, a slave in loopback with forward shall disable loopback and enable NRT mode after it does not receives MST on the active port within the MST timeout (130 ms).
- If the slave recognizes the phase switching (CPS = 1, CP = 1) it shall stop the automatically changing of the topology.

A slave can adjust 3 topology conditions in the RT channel (see Figure 16):

- fast-forward (normal condition)
- loopback P1 with forward (interrupted reception line on P2)
- loopback P2 with forward (interrupted reception line on P1)

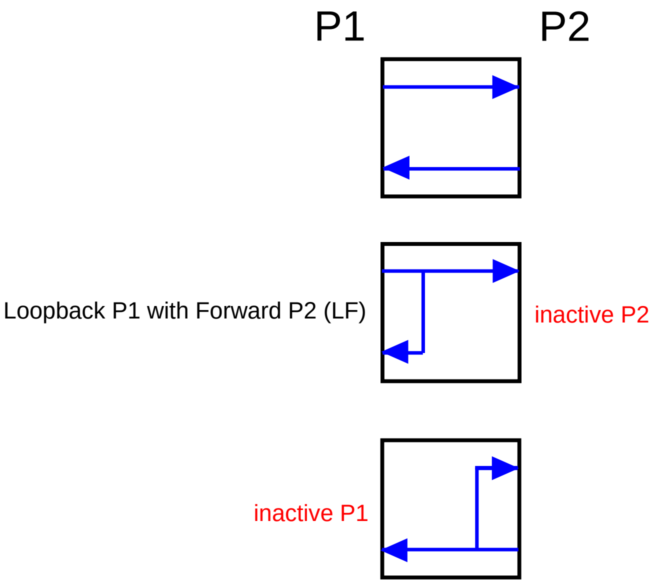

Figure 16 – Topology conditions of a slave

5.3.5 Topology conditions of a multi-slave device

A multi-slave device consists of several slaves as shown in Figure 17. The following functions shall be supported by the device and the slaves:

- S-0-1046 List of device addresses in device shall be supported by each slave.
- S-0-1037 Slave Jitter shall be supported by each slave and shall contain the same value.
- Handling of topology, sequence counter in CP0, Device Status (S-DEV) and Device Control (C-DEV) as described in clause 5.3.5.
- Deactivation of slaves within a multi-slave device:
  - If an application does not require all slaves in a multi-slave device, then the unused slaves shall be deactivated.
  - At least, one slave shall be always activated, because it shall handle the topology (e.g. redundancy etc.).
  - The functionality of the deactivation and activation of slaves within a multi-slave device is manufacturer specific.

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Each of the slaves of a multi-slave device shall have a sub-device address that is written either during start-up or can be set by an external input unit such as a DIP switch or panel.

Each slave determines its position within the topology (topology address) in CP0. It is necessary to determine the topology index consistent in a multi-slave device. This determination shall be independent of how the two ports of the device are connected and which topology is present.

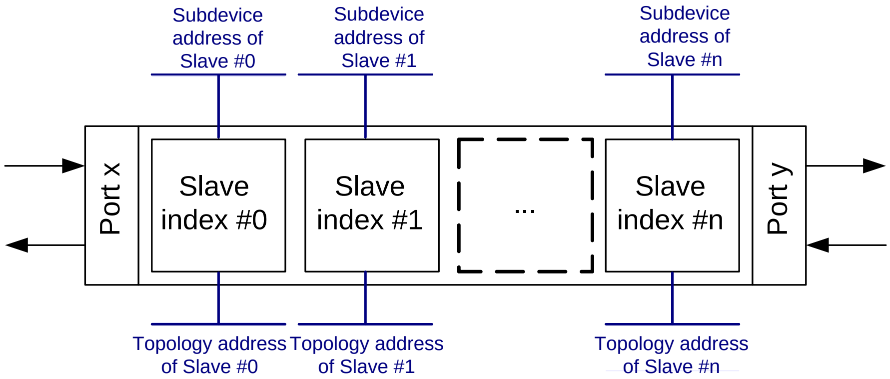

Figure 17 – Addressing of multi-slave device

It is specified that the cable from Port 1 and Port 2 can be interchanged without the master detects a change in the order of the topology. For this reason, a multi-slave device shall be insert the sub-device addresses in a different order in the AT0 in CP0, depending on the present topology.

It is also specified that the logical order corresponds to the multi-slave device shown in Figure 18. The slave right next to Port x is the slave #0 and has the smallest topology index in the multi-slave device. Then follows Slave #1, etc. up to the slave #n with the greatest topology address, which is located directly on port y.

The assignment of port x and port y to the real port 1 and port 2, is based on the received sequence counter of AT0 in CP0. This allows to replace the internal slave order of the multi-slave device. The assignment between slave and sub-device address is fixed, the topology index shall be determined. In addition, in AT0 of CP0 it is assumed that the received sequence counter on port 1 is called SEQCNT-P1 and the received sequence counter on port 2 is called SEQCNT-P2.

The following topology scenarios are possible:

- Ring and line topology: the multi-slave device is in a ring or not last in the line (see Figure 18)
- Line topology: the multi-slave device is last in the line (see Figure 19)

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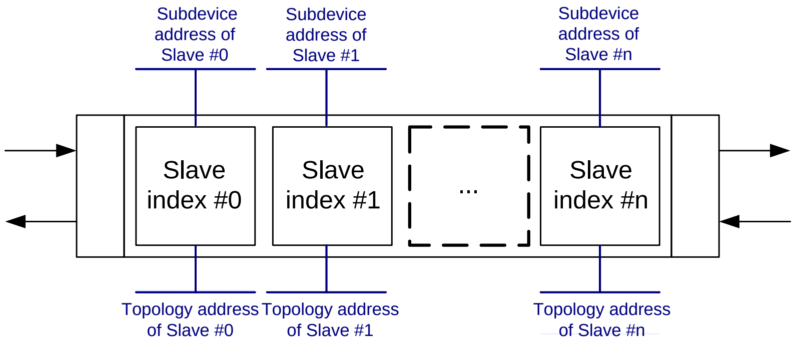

Figure 18 – Multi-slave device in ring topology or not last in line topology

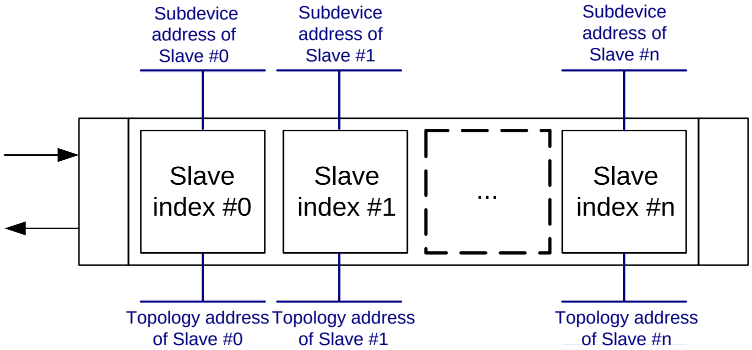

Figure 19 – Multi-slave device as last in line topology

Determination of the topology indices of a multi-slave device

Table 61, Table 62 and Table 63 contain the scenarios for line and ring with the assignment of the topology indices for slave #0 to slave #n.

Table 61 – Determination of the topology indices (1)

Type 19 telegram on P1 & P2	**P1.SEQCNT.bit15 ≠ P2.SEQCNT.bit15**	**P1.SEQCNT.bit15 = 0**	**P1.SEQCNT.bit15 = 1**
Topology	Ring	not last in line	not last in line
Sequence of topology indices	not inverted	not inverted	inverted

Table 62 – Determination of the topology indices (2)

Type 19 telegram on P1 only	**P1.SEQCNT.bit15 = 0**	**P1.SEQCNT.bit15 = 1**
Topology	last in line (P1)	last in line (P1)
Sequence of topology indices	not inverted	inverted

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Table 63 – Determination of the topology indices (3)

Type 19 telegram on P2 only	P2.SEQCNT.bit15 = 0	P2.SEQCNT.bit15 = 1
Topology	last in line (P2)	last in line (P2)
Sequence of topology indices	not inverted	inverted

Due to the described assignment of the topology indices the behavior also arises in the topology status (S-DEV) and the topology control (C-DEV) of the slaves in a multi-slave device.

The slave with the lowest topology index and the slave with the greatest topology index (slave #0 and slave #n), shall evaluate the topology bits of the device control (C-DEV) and shall set the topology bits in the device status (S-DEV). All other slaves are only virtual in relation of the topology and are always in fast-forward and shall not evaluate the topology bits in the device control and shall not change the fast-forward in the device status.

Depending of the received P telegrams or S telegrams at the two ports, the topology status of both slaves (slave #0 and slave #n) are shown in Table 64.

Table 64 – Topology status of multi-slave device

Topology	Topology status (C-DEV)		
	Slave #0	Slave #1 to #n-1	Slave #n
see Figure 20	fast-forward	fast-forward	loopback with forward
see Figure 21	loopback with forward	fast-forward	fast-forward
see Figure 22	fast-forward	fast-forward	fast-forward

The permitted topology settings of a multi-slave device are shown in Table 65. In a ring topology it is forbidden that the master set the both slaves (close to the ports) to loopback with forward simultaneously.

Table 65 – Topology settings of multi-slave device

Topology	Permitted topology settings (C-DEV)		
	Slave #0	Slave #1 to #n-1	Slave #n
see Figure 20	fast-forward	fast-forward	loopback with forward or fast-forward, for example during hot-plug, ring recovery, etc.
see Figure 21	loopback with forward or fast-forward, for example during hot-plug, ring recovery, etc.	fast-forward	fast-forward
see Figure 22	fast-forward or loopback with forward, it shall not be activated simultaneously in slave #n	fast-forward	fast-forward or loopback with forward, it shall not be activated simultaneously in slave #0

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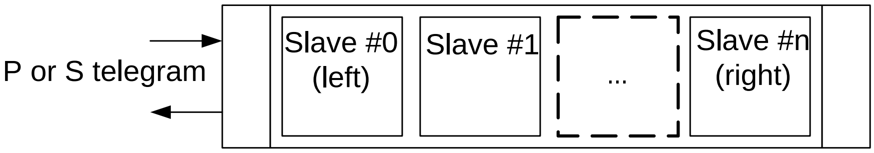

Figure 20 – Multi-slave device in line (left)

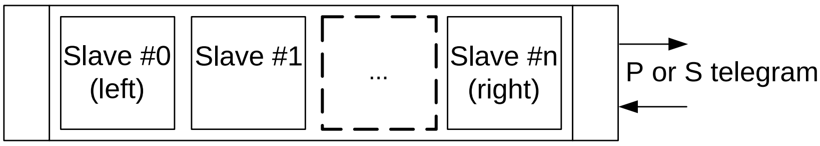

Figure 21 – Multi-slave device in line (right)

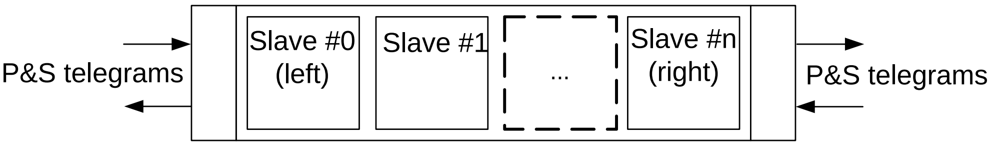

Figure 22 – Multi-slave device in ring

5.3.6 Topology state machine

The topology state machine of a slave shall consist of two states, the NRT state and the RT state (see Figure 23).

- NRT state
  - – NRT mode is activated during NRT state. The slave shall check and evaluate the MST.
  - – Functionality of a Type 19 device in NRT mode:
    - i) Standard Ethernet communication shall be active, if it is supported.
    - ii) At least store&forward shall be supported by the device, but cut-through may be supported also.
    - iii) The data from RxD (P1) shall be passed on with or without change to TxD (P2). The data from RxD (P2) shall be passed on with or without change to TxD (P1).
  - – The NRT mode shall be activated during NRT state, HP0 and UC channel.
- RT state
  - – consists of two sub-states, these are "fast-forward" and "loopback with forward".

NOTE the switching from RT Channel to UC channel and vice versa (at time t6 resp. t7) is not part of this state machine (see 7.1.10).

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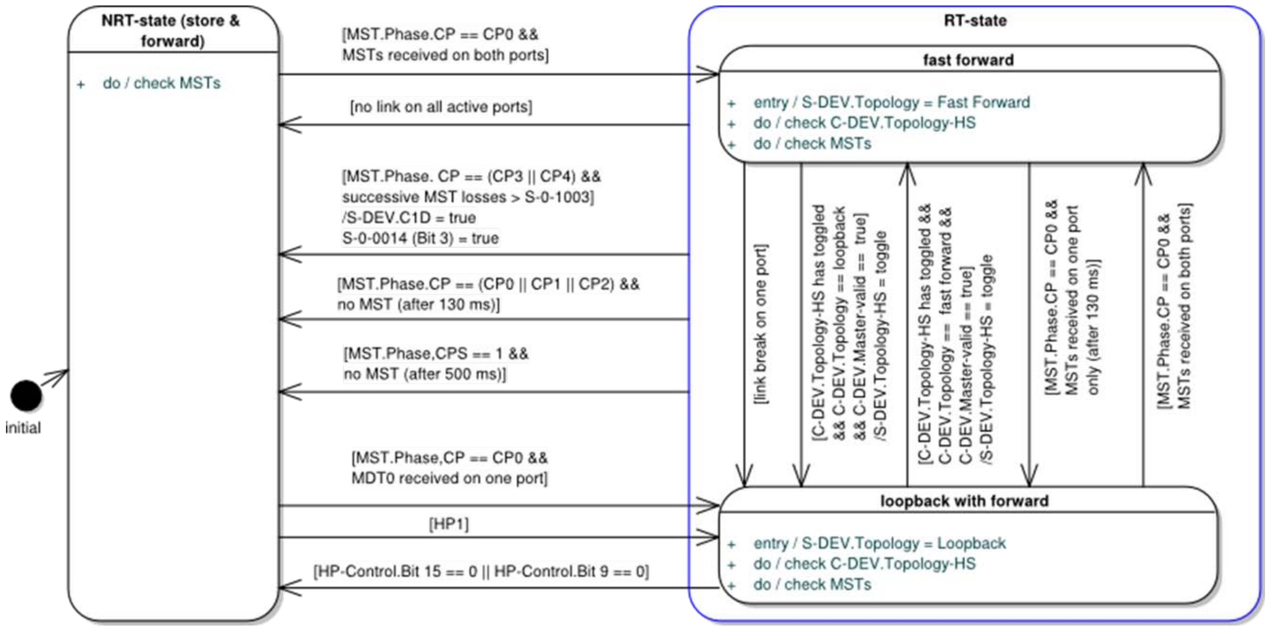

Figure 23 – Topology state machine of a slave

5.3.7 States of Topology state machine of slave

The states of the state machine are described in Table 66. The LED pattern shall be adjusted to the corresponding topology state.

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Table 66 – States of Topology state machine of slave

State	Description
NRT state (NRT mode is active)	• Upon powering on, the master and each slave shall activate NRT state independently. • NRT mode is activated during NRT state. • The collision buffer shall be administrated as described in the topology state machine. • The master shall leave NRT state to CP0 upon request by its DL user. • The slave shall check the MST of the Type 19 telegrams. If the slave recognizes a – MST with CP = 0, then it shall activate CP0 and change the topology (see 5.3.6). – MST with CP = 4, then it shall activate HP0, if hot-plug is supported. • Before entering NRT state from a state different to CP0 or HP0 the slave shall generate a link down on both ports. • In NRT state the slave may activate pattern #1 of Type 19 LED.
RT state (fast-forward)	• The slave shall pass on the received data with or without change to the other port, delayed by tREP. • The slave shall set fast-forward in the device status (bit 13 and 12 = 0). • The slave shall check the topology HS in the device control (bit 14). • The slave shall check and evaluate the MST. • The master does not have fast-forward functionality.
RT state (Loopback with forward)	• The received data shall be passed on with or without change to both ports. • Loopback with forward may be activated either on P1 or P2 depending on the topology, but not on both ports simultaneously. • If the slave is the last physical one in the line topology, it shall thus activate loopback with forward only on the port from which it receives MSTs. • The slave shall set loopback with forward depending on the topology in the device status (bit 13 and 12 = 01 or 10). • The slave shall check the topology HS in the device control (bit 14). • The slave shall check and evaluate the MST. • The master does not have loopback with forward functionality.

5.3.8 Transitions of Topology state machine

The transitions of the state machine are described in Table 67, Table 68 and Table 69. In CP0 the slave shall activate the topology transition at time T7cp0. In CP1 to CP4 the slave may activate the topology transition as fast as possible. Telegram fragment may occur if traffic is not considered for topology transition.

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Table 67 – Transitions of Topology state machine

Transition			Description
Source	**Target**	**Condition**	
NRT state	Fast-forward	CP is CP0 && MST received on both ports	During NRT state the slave shall activate fast-forward, as soon as MSTs with CP0 has been received at both ports.
NRT state	Loopback with forward	CP is CP0 && MST received on one port	During NRT state the slave shall activate loopback with forward, as soon as a MST with CP0 has been received at one port, but only as long as no MST has been received at the other port.
Loopback with forward	Fast forward	CP is CP0 && MST received on both ports	During CP0 a slave in loopback with forward shall disable loopback with forward and enable fast-forward as soon as it receives MST on both ports.
Fast-forward	Loopback with forward	CP is CP0 && MSTs received on one port only within 130 ms	During CP0, a slave in fast-forward shall activate loopback with forward on one port as soon as it does not receive MST on the other port within the MST timeout (130 ms).
NRT state	Loopback with forward	HP1	The hot-plug slave has received all HP0 parameters and activates loopback with forward.
RT state	NRT state	no MST within MST timeout (130 ms) && CP is (CP0, CP1, CP2, HP1, HP2)	If the slave does not receive MSTs within the MST timeout in CP0, CP1, CP2, HP1 or HP2, then it activates NRT state.
Loopback with forward	Fast forward	C-DEV.Topology-HS = toggle && C-DEV.Topology = fast-forward && C-DEV.Master-valid = 1	The master commands fast-forward. • If the slave still detects a Type 19 link on the inactive port, then the slave shall toggle S-DEV.Topology-HS, activate Fast-forward and shall set S.DEV.port status accordingly. The slave shall clear the warning 0xC30E4020 in S-0-0390 Diagnostic number. • If the slave does not detect a Type 19 link on the inactive port, then the slave shall toggle S-DEV.Topology-HS, remain in Loopback with forward and shall not change S.DEV.port status.
Fast-forward	Loopback with Forward	C-DEV.Topology-HS = toggle && C-DEV.Topology = loopback with forward && C-DEV.Master-valid = 1	The master commands loopback with forward, the slave toggles S-DEV.Topology-HS.
Loopback with forward	NRT state	(HP-Control.Bit 15 = 0) or (HP-Control.Bit 9 = 0)	Master cancels the hot-plug function.

Table 68 – Transitions of Topology state machine (transitions with warning)

Transition with warning			Description
Source	**Target**	**Condition**	
Fast-forward	Loopback with forward	link break on one port	A cable fault (for example: disconnection, undesired cable break) is detected at one port. If CP > CP0 the slave shall generate a warning (S-DEV.Bit 6 = 1), set the S-0-0390 Diagnostic number to 0xC30E4020 and activates loopback with forward.

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Table 69 – Transitions of Topology state machine (transitions with error)

Transition with error			Description
Source	Target	Condition	
RT state	NRT state	no link on all active ports	If CP > CP0 the slave shall generate an error (S-DEV, bit 7 = 1), sets S-0-0390 Diagnostic number to 0xC30F4020 and activates NRT state.
RT state	NRT state	MST.Phase.CPS = 1 && no MST within MST-CPS timeout (500 ms)	If the MST-CPS timeout occurs during phase switching, the slave generates an error (S-DEV, bit 7 = 1), sets the S-0-0390 Diagnostic number to 0xC30F4017 and activates NRT state.
RT state	NRT state	MST losses > S-0-1003 Allowed MST losses in CP3&CP4 && CP is (CP3 or CP4)	If the MST losses in CP3 or CP4 exceeds the value of S-0-1003 Allowed MST losses in CP3&CP4, then the slave sets S-DEV.C1D-error = 1, S-0-0014.Bit 3 = 1, if supported and sets the S-0-0390 Diagnostic number to 0xC30F4001 and activates NRT state.

5.4 Redundancy of RT communication with ring topology

5.4.1 Introduction

The master shall send all telegrams with the same content on the P channel and on the S channel (see Figure 24). Likewise, the master shall receive the telegrams from the slaves twice and process the SVC and real-time data of one valid received telegram only (either P or S telegram). If the master does not receive the selected telegram, then the master shall process the SVC and real-time data of the other telegram.

Each slave shall receive both telegrams, work on the assigned data fields in P and S channel, and pass them on in their respective channels.

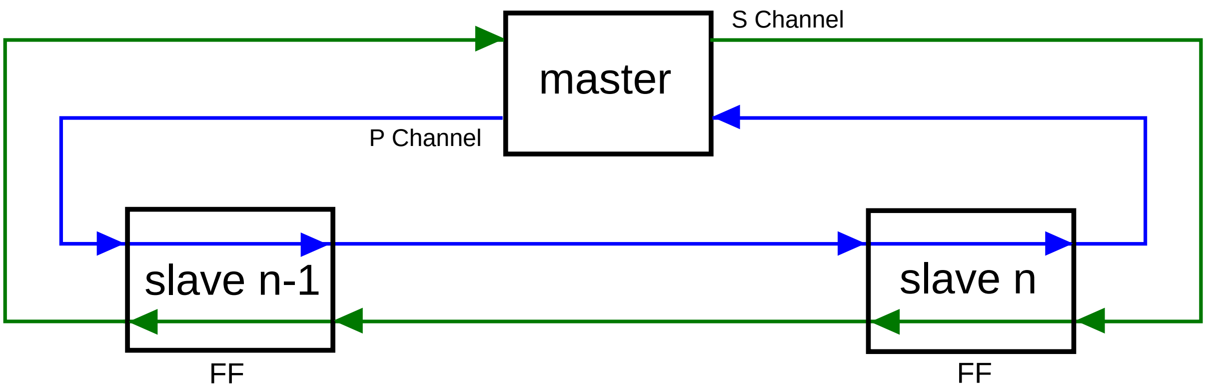

Figure 24 – Ring without break

5.4.2 Sequence with ring break

After a cable break, the slave shall switch from fast-forward to loopback with forward within less than minimal communication cycle time (tScyc, S-0-1002) and signal the changing of the topology in the device status (bits 14 – 12).

The slave activates loopback always at the undisturbed port, thereby the received RT telegrams are sent back to the master and forwarded on the disturbed port simultaneously.

In case of ring break the ring disintegrates into 1 or 2 lines (see Figure 25 and Figure 26).

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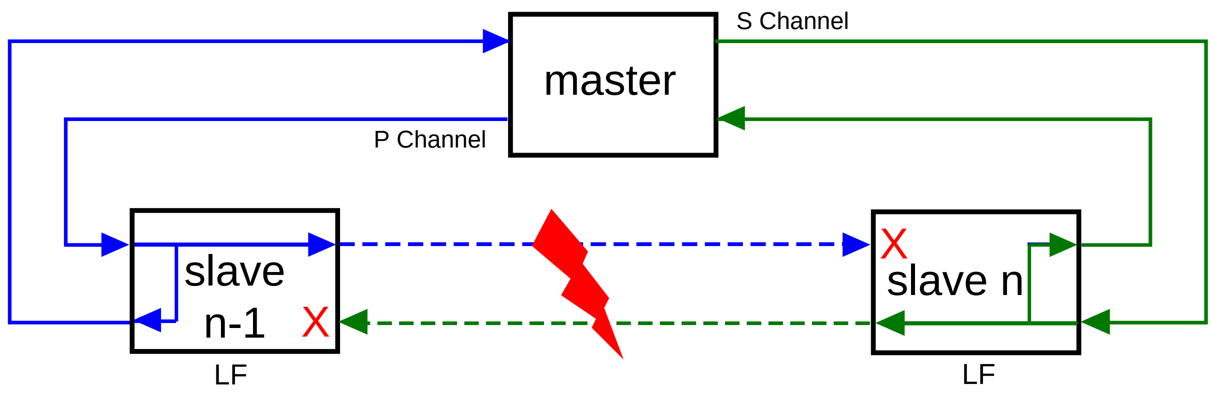

Figure 25 – Ring break

The master sends P telegrams and receives S telegrams at one port. At the other port the master sends S telegrams and receives P telegrams (see Figure 24).

When a slave changes the topology, this will be recognized by the master, because now the master sends and receives P telegrams at one port and sends and receives S telegrams at the other port (see Figure 25).

In case of a cable break between master and slave, the slave changes over the topology, this will be recognized by the master because now the master sends and receives for example P telegrams at one port and sends S telegrams and receives no telegrams at the other port (see Figure 26). In order to show the interrupted connection, the master has to analyze the device state of all slaves.

Recommendation: to serve the purpose for diagnosis, the master should save in a parameter all interrupted links (for example cable break between slave n-1 and slave n) with the sub-device addresses, the addresses of topology, date and time.

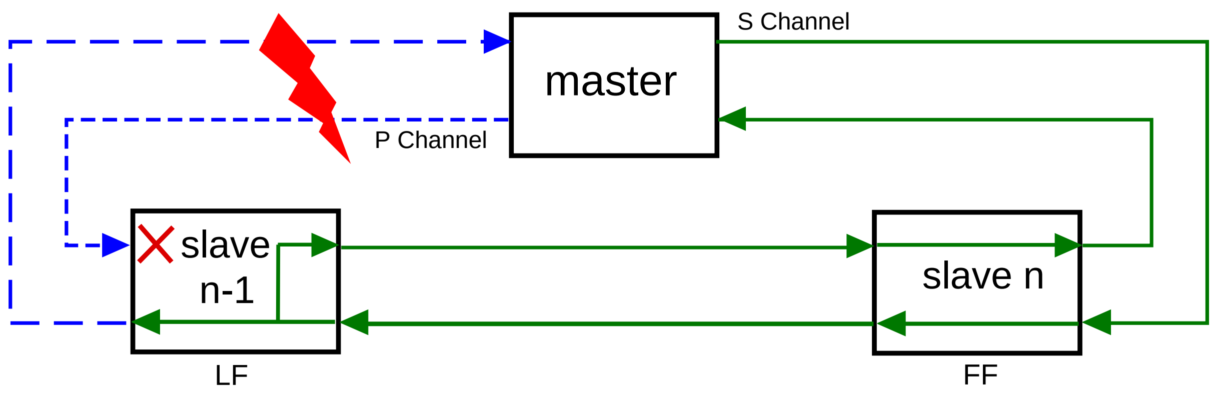

Figure 26 – Ring break on master

5.4.3 Recovery of ring topology

The slave monitors both ports and shows the state of the ports in the device status (S-DEV). With this information the master recognizes that the interruption has been removed. Before the master can close the ring it shall check that the P telegram or S telegram is received on the inactive port of the corresponding slave (see S-DEV, bit 11 and 10).

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The slave shall only close the ring, if the master commands this in the device control (C-DEV). The P channel and S channel can be closed one after another or simultaneously (see 5.4.4 and 5.4.5).

When the master has closed the P channel and S channel, the establishment of the ring has been finished. After the ring recovery in CP4 and with running synchronization the master shall transmit the S-0-1015 Ring delay of the topology to all synchronizing slaves. After that, the master shall activate the S-0-1024 SYNC delay measuring procedure command to announce the slave, that it can synchronize on the two ports again.

To support the IP switch, the master shall transmit the time slot parameters of the UC channel with broadcast address in the MDT HP field. Directly after the start of CP3 and immediately after ring recovery the master shall transmit t6 and t7 with the defined scan cycles of each parameter. The contents of the MDT HP field are shown in Table 52.

5.4.4 Recovery of P channel

In Figure 27 the slave n recognizes, that it receives again P telegrams and shows this in the device status of the S channel.

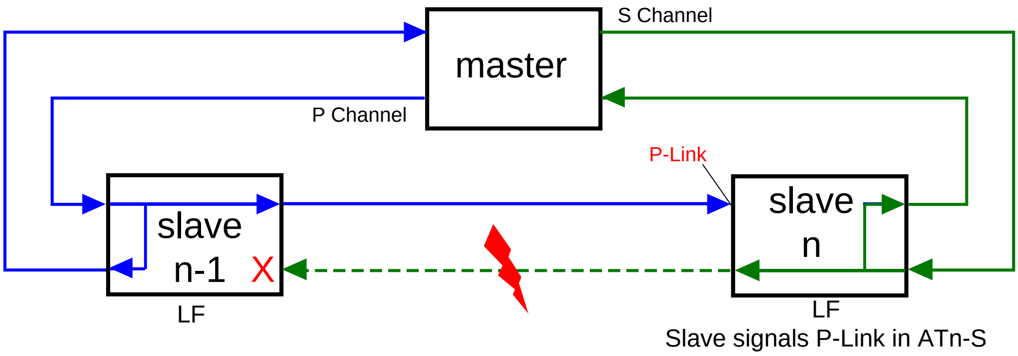

Figure 27 – Recovery of P channel (1)

Now it is possible for the master to change the topology of the slave n from loopback with forward to fast-forward (see Figure 28), in order to re-establish the P channel.

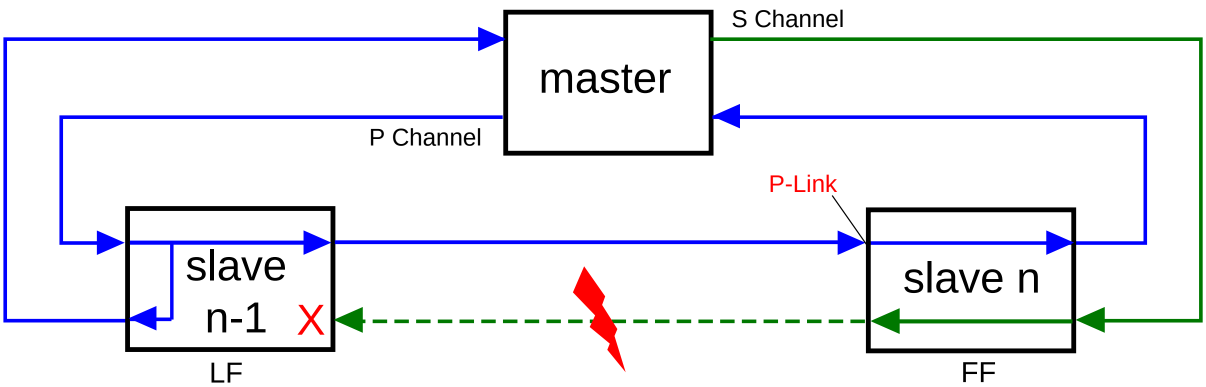

Figure 28 – Recovery of P channel (2)

5.4.5 Recovery of S channel

In Figure 29 the slave n-1 recognizes, that it receives S telegrams and shows it in the device status of the P channel.

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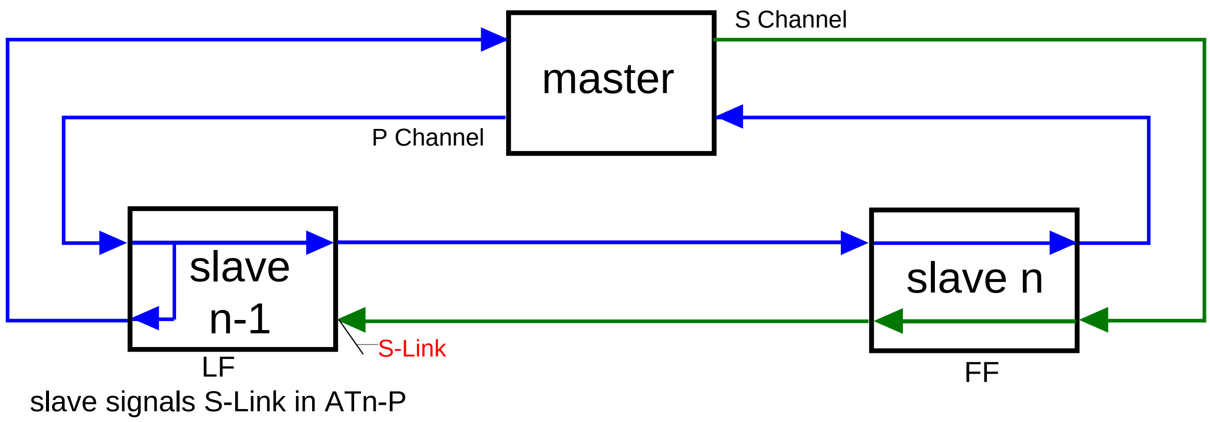

Figure 29 – Recovery of S channel (1)

Now the master can change the topology of the slave n-1 from loopback with forward to fast-forward (see Figure 30), in order to reestablish the S channel.

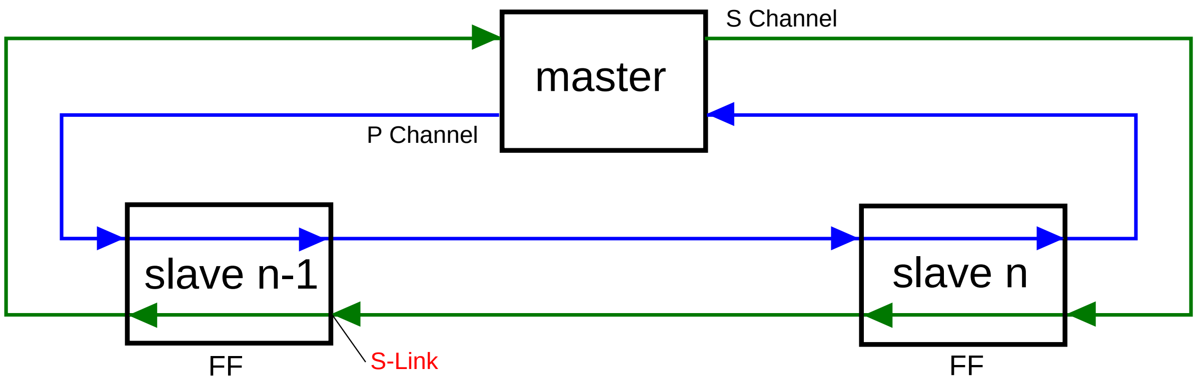

Figure 30 – Recovery of S channel (2)

5.5 Hot-plug procedure

5.5.1 Introduction

Upon an Enable_Hotplug (EHP) request by the DL user in the master device, a list of expected devices that may be hot-plugged (depending on the application) is passed to the DL. The DL user is informed by a Notify_Device_Status_Change (NDSC) if a new device has been hot-plugged.

The hot-plug mechanism provides the ability to bring devices with one or more slaves (multi-slave device) subsequently to CP4. The running Type 19 network with the participant remains in CP4. Hot-plugging is supported in CP4 with line topology only. With ring topology, a ring break has to be initiated first.

The last slave in a line topology shall continuously monitor its inactive port. If an additional device gets connected it receives all telegrams from the last slave.

The Master shall be prepared for the HP slaves, this means the telegram fields used by the hot-plug slaves shall be configured in the MDT and AT. In case of a broken ring topology, the master should activate the Hot-plug function on one channel only (P or S).

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For a Type 19 slave there are two different ways to participate in the cyclic communication of CP4. The "communication phase run-up" with the sequence from CP0 to CP4 and the "Hot-Plug procedure" with the sequence from HP0 to HP2 and switching to CP4.

An additional device shall start in the NRT state ("store and forward") as described Non-real-time state. If the additional device supports the Type 19 protocol, it shall evaluate the hot-plug field in the MDT0. Using the hot-plug fields in MDT0 and AT0, the master and the hot-plug slave shall be able to communicate. After processing through the hot-plug procedure, the hot-plug slave shall become the last slave within the line topology.

The hot-plug procedure is divided in 3 phases (HP0, HP1 and HP2).

5.5.2 Hot-plug state machine

The hot-plug state machine is shown on the right side of Figure 31. The LED pattern shall be adjusted to the corresponding hot-plug states.

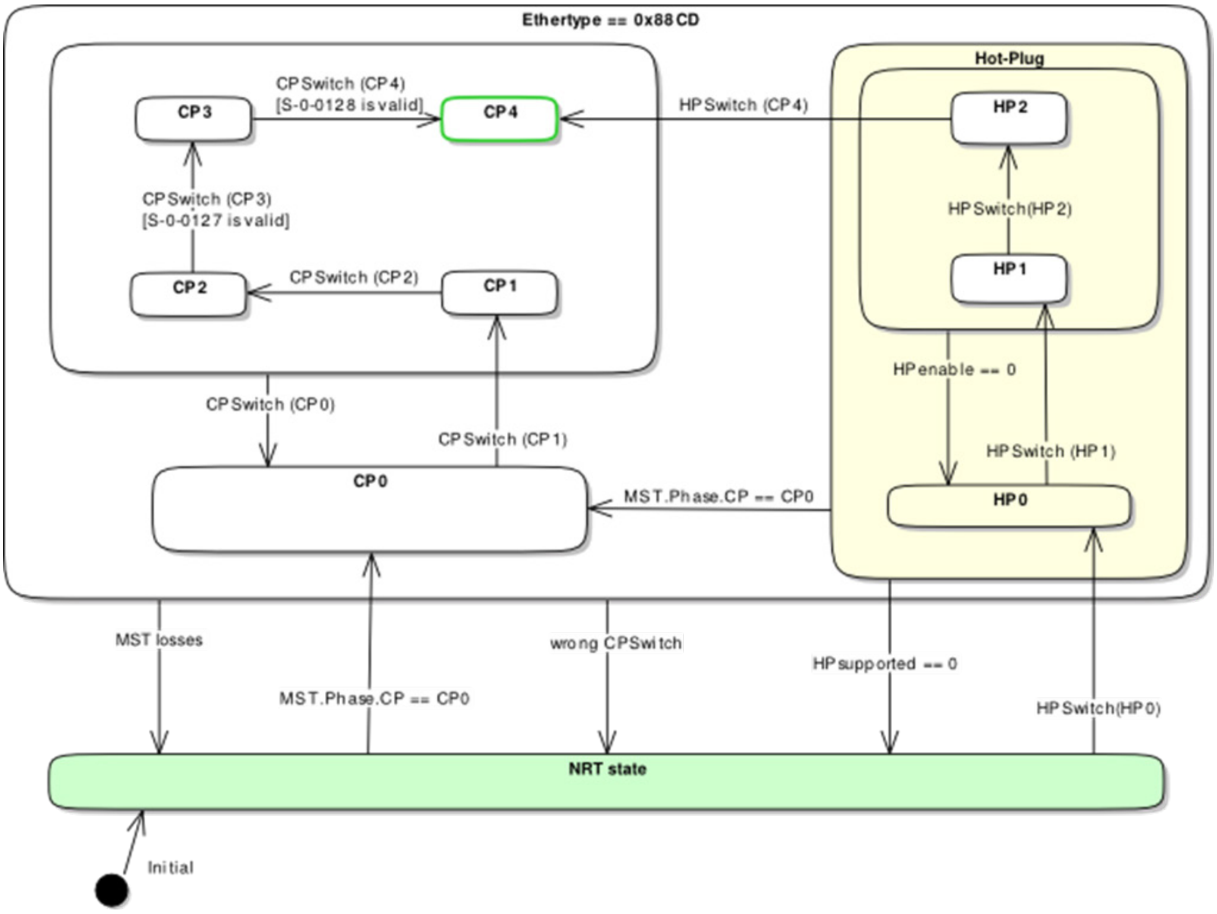

Figure 31 – Communication phase and hot-plug state machine

5.5.3 States of HP state machine

The states of the HP state machine are described in Table 70.

Table 70 – States of HP state machine

State	Description
NRT state	Upon powering on, the master and each slave shall activate NRT state independently.

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<table>
<tr><th>State</th><th>Description</th></tr>
<tr><td></td><td>NRT mode is activated during NRT state.
The collision buffer shall be administrated as described in the topology state machine.
The master shall leave NRT state to CP0 upon request by its DL user.
The slave shall check the MST of the Type 19 telegrams. If the slave recognizes a
• MST with CP = 0, then it shall activate CP0 and change the topology (see 5.3.6).
• MST with CP = 4, then it shall activate HP0, if hot-plug is supported.
Before entering NRT state from a state different to CP0 or HP0 the slave shall generate a link down on both ports.
In NRT state the slave may activate pattern #1 of Type 19 LED.</td></tr>
<tr><td>HP0</td><td>In HP0 the HP slave is in NRT state and can not transmit Type 19 telegrams to the master.
The HP slave
• activates the parametrization level (PL).
• handles the received telegrams in store&forward or cut-through.
• evaluates additionally the MST and MDT-HP field.
• generates pattern #7 of Type 19 LED.
The master shall set
• HP supported (HP control, bit 15=1),
• HP enable (HP control, bit 9=1) and
• starts the transmission of the HP0 parameters in the MDT-HP field by using the broadcast address.
The master shall repeat the transmission of each HP0 parameter in successive communication cycles (like defined in HP1 for the slave), because the HP slave does not know yet the communication cycle time.
The HP0 parameters are common to all hot-plugging slaves:
• S-0-1002 Communication Cycle time (tScyc)
• S-0-1017 UC transmission time
• S-0-1027.0.1 Requested MTU
Communication Version (MDT0 of CP0)
• S-0-1010 Lengths of MDTs
• S-0-1012 Lengths of ATs
The HP slave shall read the HP0 parameters only,
if the broadcast address (4095) is valid and
the HP enable is set (HP control, bit 9=1) by the master.
The contents of the MDT-HP field to transmit the HP0 parameters are shown in Table 71.</td></tr>
<tr><td>HP1</td><td>The master shall change the topology state of the last slave from loopback with forward to fast-forward.
The HP slave shall generate pattern #8 of Type 19 LED.
The master shall scan all HP slaves of the HP device (single-slave or multi-slave device) and transmit individual HP1 parameters to each HP slave.
Scanning of HP slave with slave index
Definition of slave index:
In a single-slave device the slave index shall be 0.
In a multi-slave device the slave index shall start with 0, 1, 2, etc.
During the scanning of the HP slaves the master shall set the device address to 0. The Master shall start the scanning with slave index 0 and increments the index by 1 for the next slave etc. The scan cycles of each parameter are defined as follows:
tscyc ≤ 2ms --> scan cycles = (2ms/tScyc) * 10 cycles
tscyc > 2ms --> scan cycles = 10 cycles
The HP slave shall match the slave index and inserts the corresponding device address in the AT-HP field. The HP slave shall react to a changing of slave index in the AT-HP field within the given amount of scan</td></tr>
</table>

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State	Description
	cycles. If a HP slave is addressed with slave index which is not present in the HP device, then the HP device shall set the device address to 4093 (0xFFD) and match the slave index in the AT-HP field. The master shall stop the scanning of slaves if it receives 4093 as device address in the AT-HP field. If the master did not scan all present HP slaves, then the HP device sends an error message in the HP status (bit 8=1 and error code = 5). **Transmission of HP1 parameter** If the master has scanned all HP slaves, the master shall transmit the following slave specific HP1 parameters to all HP slaves of one HP device. The master shall use the device address of the HP slave. If the HP slave did not detect its own device address in the MDT-HP field, then the HP slave generates an error message in the HP status (bit 8=1 and error code = 4). List of HP1 parameter: • S-0-1013 SVC offset in MDT; • S-0-1014 SVC offset in AT; • S-0-1042 Topology index. The contents of the MDT-HP field to transmit the HP1 parameters are shown in Table 72. The reception of each HP1 parameter shall be acknowledged by the addressed HP slave (MDT-HP address = device address of HP slave) in the AT-HP field. Two cases are possible with S-0-1042 Topology index: Case 1: If the HP slave does not support S-0-1042 Topology index, then it shall ignore the reception and shall not generate any error. Case 2: If the HP slave supports S-0-1042 Topology index but the master did not transmit S-0-1042, then the slave shall not generate any error also. The acknowledgment of a HP slave is shown in Table 73.
HP2	The master shall fully configure the HP slave using SVC (service channel) as described in CP2. The HP slave shall write protect the HP0 and HP1 parameters and shall generate pattern #9 of Type 19 LED. After the transmission of the communication parameters as in CP2, the master shall activate the S-0-0127 CP3 transition check. The HP device shall process the procedure command as described in CP2. The master can transmit application parameters as in CP3 and shall produce valid real-time data (e.g. command values).

Table 71 – MDT hot-plug field in HP0

MDT-HP address	HP control	MDT-HP INFO	Description
4095 (broadcast)	0x8201	value of tScyc (Communication cycle time)	S-0-1002 Communication Cycle time (tScyc)
4095	0x8202	value of t6 (beginning of UC channel)	S-0-1017 UC transmission time, list element 0
4095	0x8203	value of t7 (end of UC channel)	S-0-1017 UC transmission time, list element 1
4095	0x8204	value of MTU	S-0-1027.0.1 Requested MTU
4095	0x8205	value of Communication version (MDT0 of CP0)	Communication version has no IDN
4095	0x8210 0x8211 0x8212 0x8213	value of MDT0 length value of MDT1 length value of MDT2 length value of MDT3 length	S-0-1010 Lengths of MDTs, list element 0 S-0-1010, list element 1 S-0-1010, list element 2 S-0-1010, list element 3
4095	0x8220 0x8221	value of AT0 length value of AT1 length	S-0-1012 Lengths of ATs, list element 0 S-0-1012, list element 1

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	0x8222 0x8223	value of AT2 length value of AT3 length	S-0-1012, list element 2 S-0-1012, list element 3

Table 72 – MDT hot-plug field in HP1

MDT-HP address	HP control	MDT-HP INFO	Description
device address of HP slave	0x8280	value of MDT-SVC offset	S-0-1013 SVC offset in MDT
device address of HP slave	0x8281	value of AT-SVC offset	S-0-1014 SVC offset in AT
device address of HP slave	0x8282	value of Topology index	S-0-1042 Topology index if supported by the master

Table 73 – AT hot-plug field in HP1

AT HP address	HP status	AT HP INFO	Acknowledgment of
device address of slave	0x0080	don't care	MDT-SVC offset
device address of slave	0x0081	don't care	AT-SVC offset
device address of slave	0x0082	don't care	Topology index (only acknowledged if supported by master and slave, otherwise ignored by slave)

5.5.4 Transitions of HP state machine

The transitions of the state machine are described in Table 74.

Table 74 – Transitions of HP state machine

Transition		Condition	Description
Source	Target		
NRT-State	HP0	HPSwitch(HP0)	If a slave is connected during CP1 to CP4 and recognizes a MST of CP4 and the slave supports hot-plug, then it switches to hot-plug phase 0 (HP0) and evaluates the Hot-plug field of MDT0. If the last slave in a line topology signals a link in S-Dev.Topology & Port status at its inactive port, then the master recognizes an additional connected device (slave or Ethernet device) and shall activate the hot-plug procedure by setting the HP control, bit 15 to 1.
HP0	HP1	HPSwitch(HP1)	If the HP slave has received and checked all HP0 parameters without error, then the HP slave shall switch to HP1 and change the topology state to loopback with forward. This has to take place at the port on which the HP slave has received the HP0 parameters. If the last slave in line topology signals a Type 19 link in S-Dev.Topology & Port status at its inactive port, then the master shall switch to HP1.
HP1	HP2	HPSwitch(HP2)	If all HP slaves of one HP device have received and checked all HP1 parameters without error, then the master shall switch to HP2. For that the master shall set bit 8=1 in the HP control and the MHS=1 in the related SVC control. After that the HP slave shall set AHS=1 and SVC valid=1 in the SVC status of its assigned SVC in the AT. If an error occurs in the HP slave during switching to HP2 (e.g. faulty parameters), then it

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Transition		Condition	Description
Source	**Target**		
			generates an error message in the HP control (bit 8=1 and error code = 2). In this case the master shall prepare the switching to HP0. Master and HP slave shall activate HP2 if no error occurs.
HP2	CP4	HPSwitch(CP4)	The master shall initiate the HP device to leave HP2 using S-0-0128 CP4 transition check to switching to CP4. The HP device shall process the procedure command as described in CP3. The HP slave activates CP4 when it generates a positive acknowledgment of the S-0-0128 CP4 transition check and the slave valid is set to 1 in the device status.
HP1..HP2	HP0	HPenable == 0	Case 1, HP1: If the master does not get a response from the scanned HP slave within this defined time, then the master shall stop the hot-plug procedure with an error message and shall prepare the switching to HP0. Case 2, HP1: If the transfer of one HP1 parameter from one HP slave of the HP device is acknowledged with error, then the master shall stop the hot-plug procedure with an error message and shall prepare the switching to HP0. The acknowledgment with possible errors of a HP slave is shown in Table 75. Case 3, HP2: If an error occurs in the HP slave during HP2 and the master is not able to detect the error, then the master shall prepare the switching to HP0. Prepare switching to HP0: Before the master switches to HP0, it shall activate loopback with forward at the last slave in line and waits of changed topology of last slave. After that, the master shall set the HP control, bit 9 to 0 and switches to HP0.
Hot-plug	NRT state	HPsupported==0	The HP slave shall switch from each HP phase to NRT state with one of the following conditions: If the HP slave does not receive a MST within a time of 130 ms. If the master does not support hot-plug by setting the HP control, bit 15 to 0.
Hot-plug	CP0	MST.Phase.CP == CP0	The HP slave shall switch to CP0 if the HP slave receives a MST with CP = CP0.

Table 75 – AT hot-plug field in HP1 (error)

AT-HP address	HP status	AT-HP INFO	Error of
device address of slave	0x0180	don't care	MDT-SVC offset
device address of slave	0x0181	don't care	AT-SVC offset
device address of slave	0x0182	don't care	Topology index (only if supported, otherwise ignored)

5.6 Status procedures

Upon a Get_Device_Status (GDS) request by the DL user in the master device, the status word of the specified device is returned to the DL user.

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Upon a Set_Device_Status (GDS) request by the DL user in the master device, the control word of the specified device is set.

Upon a Get_Network_Status (GNS) request by the DL user in the master device, the status of the network is returned to the DL user.

6 Data transmission methods

6.1 Overview

Data transmission methods are the means by which a DLE performs its functions and affects the behavior of the DL-protocol. Methods are initiated, executed and terminated under the control of invoked services, as specified in the Type 19 DL-service.

6.2 Service channel (SVC)

6.2.1 SVC handling

Acyclic data is exchanged between a master and a slave device upon a Read (RD) request initiated by the DL user in a master device. To transmit this data, the SVC INFO field shall be reserved for the service channel in the MDT (see 4.5.7.3.3) and in the AT (see 4.6.7.3.3). Special bits in the MDT-SVC control and the AT-SVC status shall be used to control execution in the service channel. Therefore, the master shall be able to support a separate service channel for every used slave device.

With a SVC transmission, the following operations shall be possible:

- initialization of the Type 19 communication;
- transmission of all data block elements of a parameter;
- transmission of procedure commands;
- changing limit values on demand;
- changing control loop parameters on demand;
- obtaining detailed status messages from a slave device;
- diagnostic functions.

Any SVC transmission shall always be initiated and controlled by the master. The operations, “read data block element” or “write data block element”, shall be from the perspective of the master. All operations shall always relate to the last transmitted IDN.

The SVC transport of parameter or of a procedure command shall be handled via a predetermined handling and proceeding sequence (see Figure 32) for individual actions. The master shall follow strictly the outline of these diagrams.

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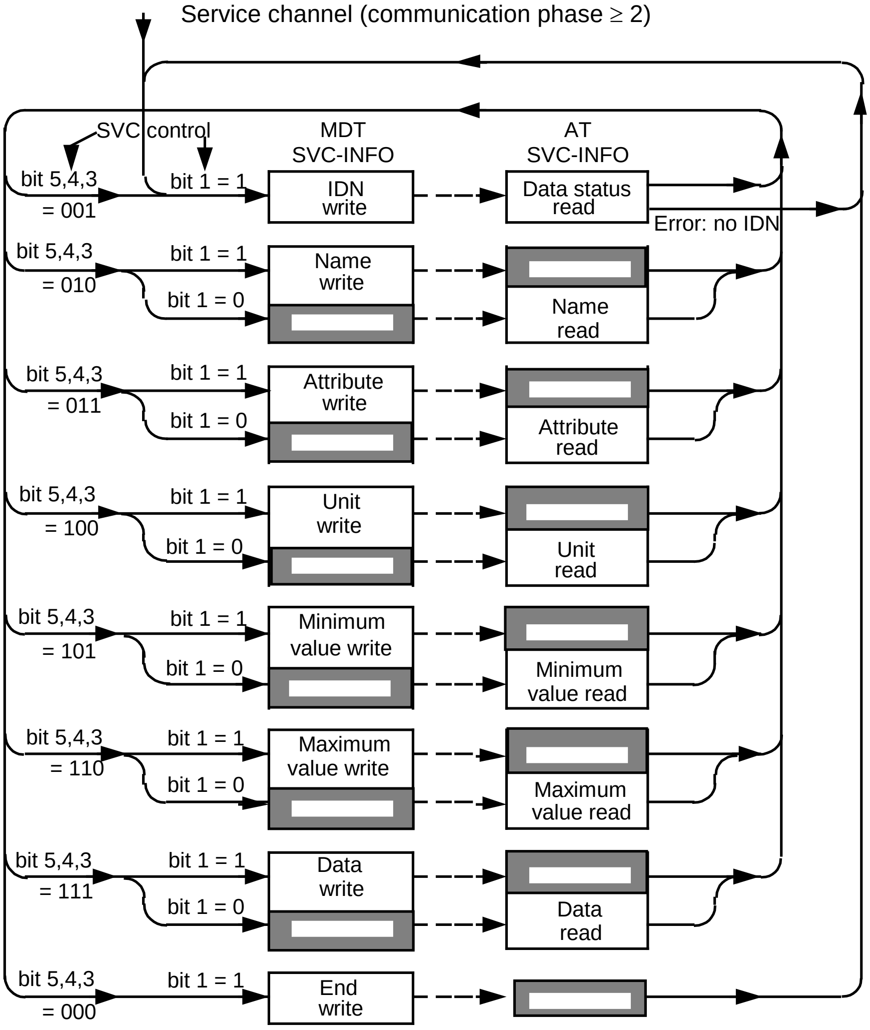

Figure 32 – Service channel handling diagram

6.2.2 Opening and closing SVC

- Opening SVC: The master shall open the SVC by transmitting the IDN of the parameter (SVC control, bits 5, 4, 3 = 001, element 1). Every access to the data block elements 2-7 refers to the last transmitted IDN. The slave shall respond by transmitting the data status or the procedure command acknowledgment of the received IDN.
- Closing SVC: The SVC of the previous IDN shall be closed by opening the SVC for a new IDN. Optionally the master may close the SVC by transmitting the data block element 0 (SVC control, bits 5, 4, 3 = 000, element 0).

6.2.3 Selection of data block element

During the next step, the master shall indicate which elements of the data block shall be processed. For this purpose, the master shall set bits 5, 4 and 3 accordingly in the SVC control.

6.2.4 Changing of data block element

Changing the data block element during transmission in progress shall be possible without an error message only if the following bits have the status given in Figure 33.

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Table 76 – Condition for modifying data block elements

Information	SVC control bit	SVC status bit	bit value
Handshake bits equal	bit 0	bit 0	MHS = AHS
Busy		bit 1	0
SVC valid		bit 3	1

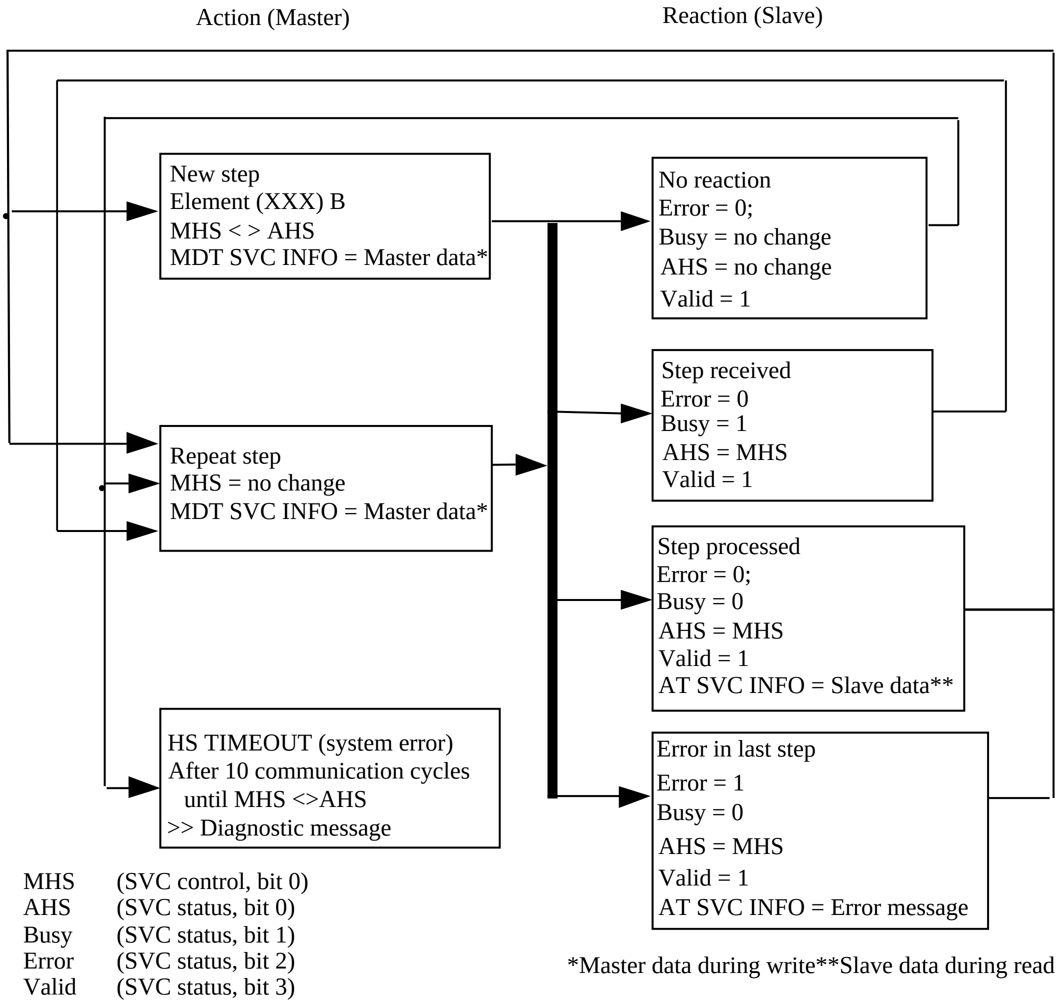

Figure 33 – Communication step proceeding diagram

6.2.5 Transmission steps

Depending on the length of the data block elements which need to be transmitted and of the length of the SVC INFO field, several steps shall be performed. Every step shall transport four octets of data.

Table 77 shows the necessary steps for the individual data block elements of a parameter.

Table 77 – List of data block element and step numbers

Data block element	Description	Requirement	Number of steps
1	IDN	Mandatory	1
2	Name	Optional	1 to 64
3	Attribute	Mandatory	1

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Data block element	Description	Requirement	Number of steps	
4	Unit	Optional	1 to 16	
5	Minimum value	Optional	1or 2	
6	Maximum value	Optional	1or 2	
7	Operation data	Mandatory	Fixed length:	1 or 2
			Variable length:	1 to 16 384
0	**Closing** the service channel		1	

The error messages “data block element transmission too long” shall be executed by the slave if the current data block element is transmitted completely and the master indicates the transmission in progress (SVC control, bit 2 = 0).

The error messages “data block element transmission too short” shall be executed by the slave if the current data block element is not transmitted completely and the master indicates the last transmission (SVC control, bit 2 = 1).

The master shall indicate a transmission in progress (SVC control, bit 2 = 0) or a transmission in progress (bit 2 = 0) or the transmission of the last 4 octets (SVC control, bit 2 = 1). If the length of the data block element is ≤ 4 octets, just one step is required. In this case the master shall set the last transmission (SVC control, bit 2 = 1).

Access to an IDN with variable length without operation data (data block element = 4 octets):

- The master does not know the length of the data block element and sets transmission in progress (SVC control, bit 2 = 0).
- Therefore the slave generates the error message “data block element transmission too long”.
- The master may read the same data block element with last transmission (SVC control, bit 2 = 1) to get the 4 octets lengths indication.

6.2.6 SVC valid

Master and slave shall read SVC information in each cycle, either on port1 or on port2 depending on topology. Should it fail on either port, it shall automatically read on the other port.

Master and slave shall always write identical SVC information on both ports.

The master shall evaluate the slave’s SVC answer only if it reads “SVC valid” = 1 (SVC status, bit 3). It shall not evaluate it if “SVC valid” = 0 (invalid).

The SVC valid is set to 1 by the slave in CP1.

6.2.7 Handshake bits

During SVC transmissions, the transport of every step shall be secured by two service transport handshake bits. These shall be the bits 0 in the SVC control (MHS) and in the SVC status (AHS).

For every new step during the transmission, the master shall toggle the MHS-bit. The slave shall recognize by the toggled MHS-bit that a new step needs to be executed. After the slave has received the required step and secured it for processing, it shall proceed to set its AHS-bit equal to the MHS-bit. By comparing the MHS-bit with the AHS-bit, the master and the

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slaves shall always be able to recognize the actual transport status during SVC transmission. see Table 78.

Table 78 – SVC channel evaluation

Perspective	Condition	Description
Master	AHS bit = MHS bit (SVC valid = 1)	The step was received by the slave and secured, slave starts processing. The master shall wait for processing acknowledgment (busy = 0, bit 1 in the SVC status)
	AHS bit ≠ MHS bit or SVC valid = 0	The steps were not yet received or secured by the slave. The master shall repeat the last step
Slave	MHS bit = AHS bit	The master does not require a new step, slave repeats the last step
	Master MHS-bit ≠ slave AHS-bit	The master requests a new step

The service transport handshake bits shall enable the slaves and the master to insert “wait cycles” during the transmission, for example:

- if more than one cycle will be required for receiving or transmitting a step;
- if a new step has not been recognized due to an error during the transmission;
- if the master does not issue any new steps at this time.

During every “wait cycle”, the master or the slave shall transmit the data of the previous communication cycle into the SVC INFO field.

The slave shall acknowledge the proper reception of a step by matching its AHS-bit within a maximum of 10 communication cycles.

6.2.8 Read/Write

The master shall indicate in bit 1 of the SVC control whether the element will be read or written to. While writing, the MDT SVC INFO field shall be filled with the appropriate data for the slave (contents of the AT SVC INFO field are invalid).

If reading is selected, the slave shall insert the appropriate data in the AT SVC INFO field (contents of the MDT SVC INFO field are invalid).

6.2.9 Busy bit

The slave shall be able to control any SVC transmission through the busy bit. The busy bit shall indicate that the slave is processing or just finishing the requested step at this time. The master shall not be allowed to start the next step until the slave sends the processing acknowledgement (busy bit = 0). The busy bit shall allow the slave to prevent the master from forcing the steps on the slave too quickly.

A maximum time if the busy bit = 1 is not specified. The maximum acceptable dwell time and the reaction in the master is related to the application.

6.2.10 Service channel initialization

The service channel shall be initialized during CP1 and be functional for the remainder of the communication phases.

In CP1, each service channel shall start with the following status:

- the master shall set the MHS-bit to 1 in the MDT SVC control word,

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- the slave shall set “SVC valid” and AHS to 1 in the AT SVC status word; if it was requested by the master in CP1,
- all other bits in SVC control or SVC status shall be set to 0,
- all bits in the SVC INFO fields are invalid.

Starting with CP2, the MDT SVC (control and INFO) and the AT SVC (status and INFO) become valid.

During phase switching the state of MHS and AHS shall be saved in the master and the slaves. The saved state shall be restored in the next CP.

6.2.11 Reaction to SVC handshake timeout

A handshake (HS) timeout shall occur if any addressed slave does not acknowledge its AHS-bit in the Status word after 10 communication cycles in CP2 to CP4. During CP1, a slave shall be registered as not present if the AHS-bit has not been set to a logical 1 within the maximum identification time of the master (see Table 79).

Table 79 – Reaction to handshake timeout

CP	Reaction in master	Reaction in the slave
2-4	Display of an error message. The master responds with an error handling procedure that may be stored in the control unit and may then switch back to CP0	

6.2.12 Reaction to error messages in the service channel

A valid error message for the master is present in the service channel if the slave sets bit 2 in the SVC status to 1 and the AHS-bit of the slave equals the MHS-bit of the SVC control (see Table 80).

Table 80 – Reaction to error message

CP	Reaction in master	Reaction in the slave
2-4	Displaying an error message	The step currently being processed is interrupted, the busy bit (bit 1 – SVC status) is set to 0.

6.2.13 Service channel error messages

Should an error occur in the transport mechanism of the service channel (for example, if the lengths of the operation data differ between the master and the slave, or vice versa, or if the IDN is undefined), the slave shall announce it by setting the error bit (bit 2) in the status word and by writing an error code into the service INFO field of its AT.

The slave shall be allowed to report an error message only if a new processing step is issued by the master, which is in any of following cases:

- MHS-bit ≠ AHS-bit (step not yet secured);
- busy bit = 1 (step still in process).

If the slave recognizes an error, it shall ignore the actual step, interrupt and acknowledge by:

- setting the AHS-bit equal to the MHS-bit (if not already acknowledged in a previous cycle);

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- setting the error bit to 1 (SVC status, bit 2);
- setting the busy bit to 0;
- setting the SVC valid to 1;
- sending the error codes in the AT SVC INFO field (see 4.6.7.3.3).

If the master intends to start a transmission of an element after an error message, the slave shall update the SVC status and AT SVC INFO.

All possible SVC error messages are shown in Table 81.

Table 81 – Error messages

Error code	Description
0x0nnn	General error
0x0000	No error in the service channel
0x0001	Service channel not open
0x0009	Invalid access to closing the service channel
0x1nnn	Element 1 (Identification number)
0x1001	IDN not available
0x1009	Invalid access to element 1
0x2nnn	Element 2 (Name)
0x2001	Name not available
0x2002	Name transmission too short
0x2003	Name transmission too long
0x2004	Name cannot be changed (read only)
0x2005	Name is write-protected at this time
0x3nnn	Element 3 (Attribute)
0x3002	Attribute transmission too short
0x3003	Attribute transmission too long
0x3004	Attribute cannot be changed (read only)
0x3005	Attribute is write-protected at this time
0x4nnn	Element 4 (Unit)
0x4001	Unit not available
0x4002	Unit transmission too short
0x4003	Unit transmission too long
0x4004	Unit cannot be changed (read only)
0x4005	Unit is write-protected at this time
0x5nnn	Element 5 (Minimum value)
0x5001	Minimum input value not available
0x5002	Minimum value transmission too short
0x5003	Minimum value transmission too long
0x5004	Minimum value cannot be changed (read only)
0x5005	Minimum value is write-protected at this time
0x6nnn	Element 6 (Maximum value)
0x6001	Maximum input value not available
0x6002	Maximum value transmission too short
0x6003	Maximum value transmission too long

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Error code	Description
0x6004	Maximum value cannot be changed (read only)
0x6005	Maximum value is write-protected at this time
0x7nnn	Element 7 (Operation data)
0x7002	Operation data transmission too short
0x7003	Operation data transmission too long
0x7004	Operation data cannot be changed (read only)
0x7005	Operation data is write-protected at this communication phase
0x7006	Operation data is smaller than the minimum input value
0x7007	Operation data is greater than the maximum input value
0x7008	Invalid operation data: Configured IDN will not be supported, invalid bit number or bit combination
0x7009	Operation data write protected by a password
0x700A	Operation data is write protected, it is configured cyclically. (IDN is configured in the MDT or AT. Therefore writing via the service channel is not allowed).
0x700B	Invalid indirect addressing: (for example, data container, list handling)
0x700C	Operation data is write protected, due to other settings. (for example, operation mode, sub-device is enabled etc.)
0x700D	Invalid floating point number
0x700E	Operation data is write protected at parameterization level
0x700F	Operation data is write protected at operating level
0x7010	Procedure command already active
0x7011	Procedure command not interruptible
0x7012	Procedure command at this time not executable (for example, in this phase the procedure command cannot be activated).
0x7013	Procedure command not executable (invalid or false parameters)
0x7014	The received current length of list parameter does not match to expectation
0x71nn	Segmentwise SVC access for parameters with variable length
0x7101	IDN in S-0-0394 not valid
0x7102	Empty list in S-0-0397 not allowed for write access
0x7103	Maximum length of the list in S -0-0394 is exceeded by take-over of the list segment.
0x7104	Read access only: The length of the list segment as of the list index exceeds the current length of the list in S -0-0394.
0x7105	IDN in S-0-0394 is write protected
0x7106	Operation data in list segment is smaller than the minimum input value
0x7107	Operation data in list segment is greater than the maximum input value
0x7108	Invalid list index in S-0-0395
0x7109	Parameter in IDN S-0-0394 does not have variable length
0x710A	IDN S-0-0397 not permitted as operation data in S-0-0394
0x8nnn	(reserved for master internal error codes)
0xAnnn	Reserved
0xBnnn	Reserved
0xCnnn	Reserved
0xDnnn	Error codes are not generated and transmitted via SVC
0xD000	no error

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Error code	Description
0xD001	service channel (temporarily) not available
0xD002	service channel engaged by an application
0xD003	service channel busy, slave is processing previous request
0xD004	Type 19 slave not reachable
0xD005	service channel transaction aborted
0xD006	writing this element is not supported by the service channel
0xEnnn	(reserved for master internal error codes)
0xFnnn	(reserved for master internal error codes)
All other codes shall be reserved.	

6.2.14 Procedure command functions via the service channel

6.2.14.1 General

The procedure command functions shall be transmittable through the service channel. A procedure command is considered as a special type of non-cyclic data which invokes fixed functional processes in the slaves and the master. These processes may take up some time. Hence, a procedure command shall only cause a functional process to start. After a procedure command has started its function, the service channel shall become available again immediately for the transmission of non-cyclic data or for more procedure commands.

Contrary to non-cyclic data transmission, whose proceeding shall be finished with the last transmitted step, the end of a procedure command during a lengthy procedure command execution shall be indicated by the procedure command change bit (bit 5 in the device status). The master shall also be able to interrupt a procedure command during its execution.

Every procedure command shall be assigned to an IDN. Not all data block elements of the parameter are defined, however, and other data block elements have a predetermined form. Some procedure commands are not interruptible.

6.2.14.2 Procedure command control and acknowledgment

A procedure command function shall always prompt a procedure command control from the master to the slave and a procedure command acknowledgment from a slave to the master. The procedure command control shall be data block element 7 of the parameter (data block element 7 is always represented as a bit string for procedure commands). see Table 82.

Procedure command control shall allow procedure commands to be:

- set;
- enabled for execution;
- interrupted during execution;
- canceled.

The slave shall acknowledge the transmission of a procedure command from the master via the service channel with its AHS-bit, the busy bit and the SVC valid in its SVC status.

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Table 82 – Structure of Procedure command control

Bit no,	Value	Description
15-2		(reserved)
1-0		procedure command control (PCC)
	00	procedure command is not activated or canceled
	01	procedure command is set and interrupted
	10	procedure command is canceled
	11	procedure command is set and enabled

When starting the initializing (CP0), all procedure commands inside the master shall be canceled and then the procedure command control shall be updated appropriately internally in the master.

The procedure command acknowledgment shall be part of the data status (see Table 83).

In order to receive a procedure command acknowledgment, the master shall write the IDN of the procedure command via the service channel.

When acknowledging a procedure command, the slave shall indicate the current status of the procedure command as given in Table 83.

If the master activates a procedure command, it can take several communication cycles until the slave generates the corresponding procedure command acknowledgment. Therefore it is recommended that the master scans the procedure command acknowledgment as shown in Table 83.

Table 83 – Procedure command acknowledgment (data status)

Bit no,	Value	Description
15-9		(reserved)
8		Data valid
	0	Operation data is valid
	1	Operation data is invalid
7-4		(reserved)
3-0		Procedure command acknowledgment (PCA)
	1111	error: procedure command execution impossible (procedure command change bit is set)
	0111	procedure command is activated but not yet executed
	0101	procedure command execution is interrupted
	0011	procedure command has been executed correctly (procedure command change bit is set)
	0001	procedure command is set
	0000	procedure command has been canceled
		All other codings are reserved

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With the beginning of initialization (CP0), all procedure commands within the slave shall be disabled and then the procedure command acknowledgment shall be updated appropriately internally in the slave.

6.2.14.3 Procedure command change bit

In order to inform the master of the end of a procedure command being executed in the slave, the procedure command change bit is defined in the device status (bit 5).

Only the following changes in the Procedure Command Acknowledgment (PCA) shall set the procedure command change bit:

- procedure command executed correctly (positive acknowledgment);
- error, procedure command execution impossible (negative acknowledgment).

The procedure command change bit (PCB) shall not indicate any other change of the procedure command acknowledgment (for example, an interrupt).

The master shall read the data status by writing the IDN of the procedure command and check the procedure command acknowledgment contained therein. This indicates whether the procedure command was executed positively or negatively.

At negative procedure command acknowledgment, it is recommended that the master reads the diagnosis (if desired) before the procedure command is canceled.

If a procedure command is canceled by the master, all the effects of the procedure command on the procedure command change bit in the slave shall be canceled as well. If the master has activated several procedure commands concurrently, all resulting procedure command acknowledgments shall be checked after setting the procedure command change bit in order to determine which procedure command caused the change.

As a rule, the master shall cancel a procedure command after it has been processed, irrespective of whether it was acknowledged positively or negatively.

A procedure command shall be canceled by setting bit 0 in the procedure command control to 0. This shall be independent from the actual procedure command execution state. If the slave recognizes that a procedure command is canceled it shall set the procedure command acknowledgment to 0 and set the Busy to 0 simultaneously.

The state machine in Figure 34 describes the allowed state changes for procedure commands.

For Procedure Command Control (PCC), only the values from 0x00 to 0x03 are allowed. If the value is invalid, the slave shall generate the error message “invalid operation data” (0x7008) in the SVC INFO.

A state change to “procedure command not set” (PCA = 0x00), shall only be possible by canceling the procedure command.

If more than one procedure command execution is active and the “Procedure Command Change Bit” (PCB) is set by more than one procedure command, this bit is reset in the device status when all procedure commands have been canceled which had set the bit.

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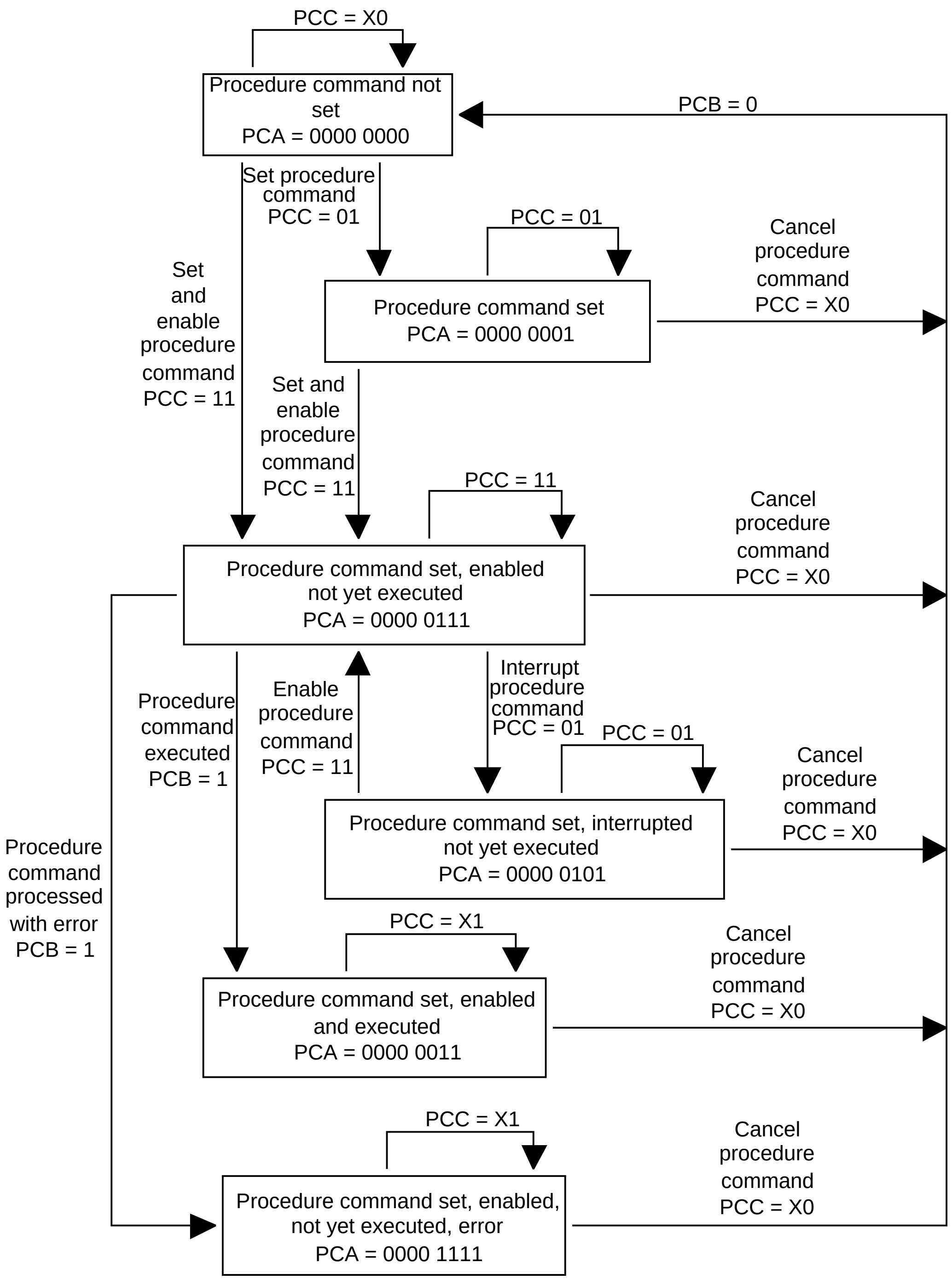

Figure 34 – State machine for procedure command execution

Figure 35 shows the sequence of procedure command handling that shall be met by the master.

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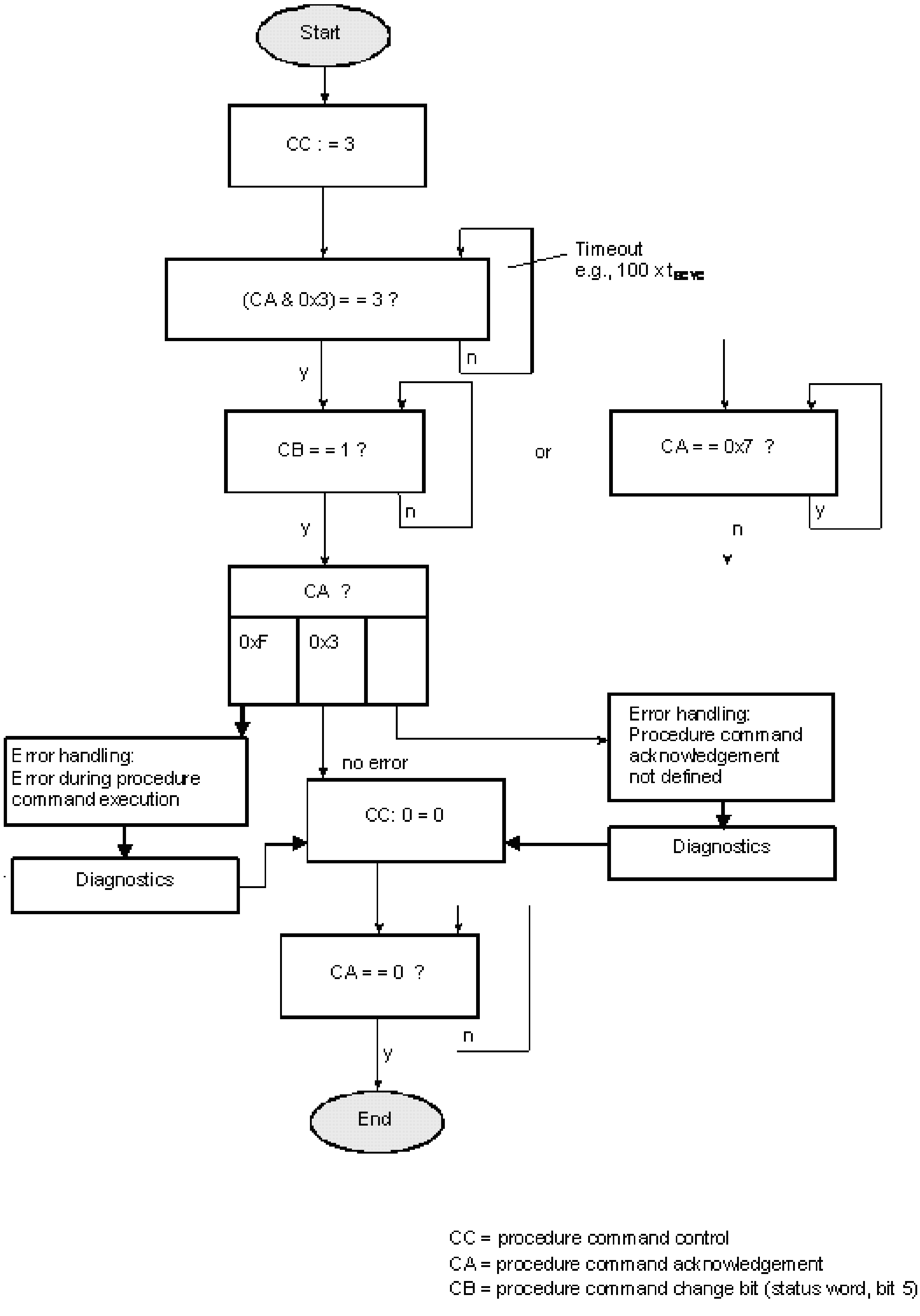

Figure 35 – Interaction of procedure command control and acknowledgement

6.2.14.4 Procedure command execution

In the following Figure 36, Figure 37 and Figure 38, the interactions between the master and the slave are represented, including procedure command executions with or without interruption and procedure command executions with error messages.

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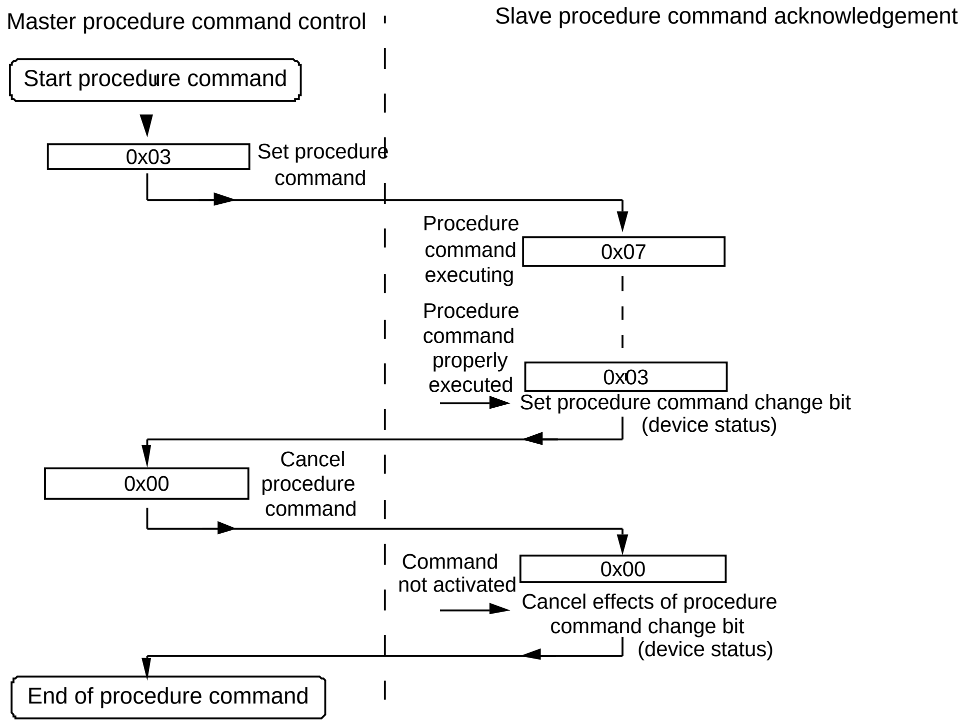

Figure 36 – Procedure command execution without interrupt

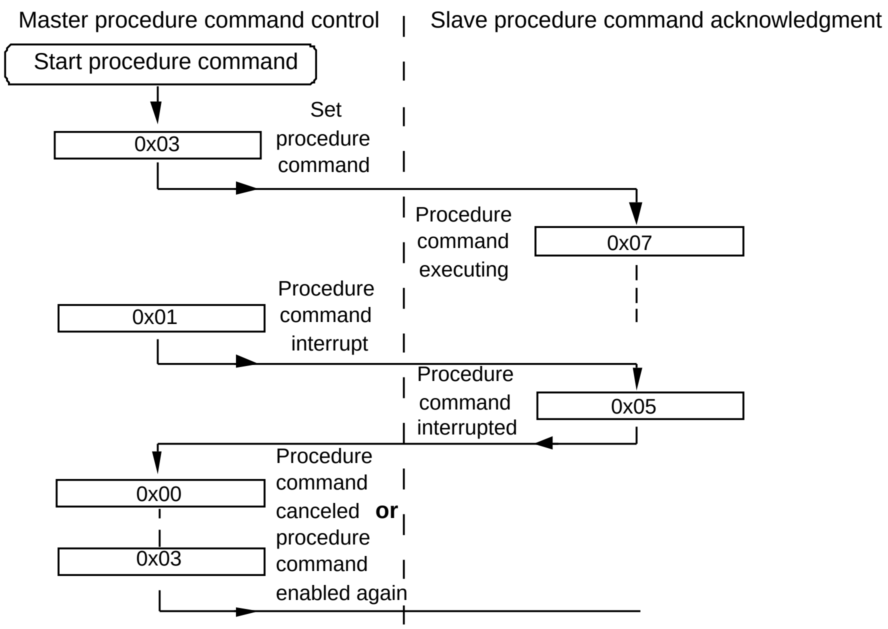

Figure 37 – Procedure command execution with interrupt

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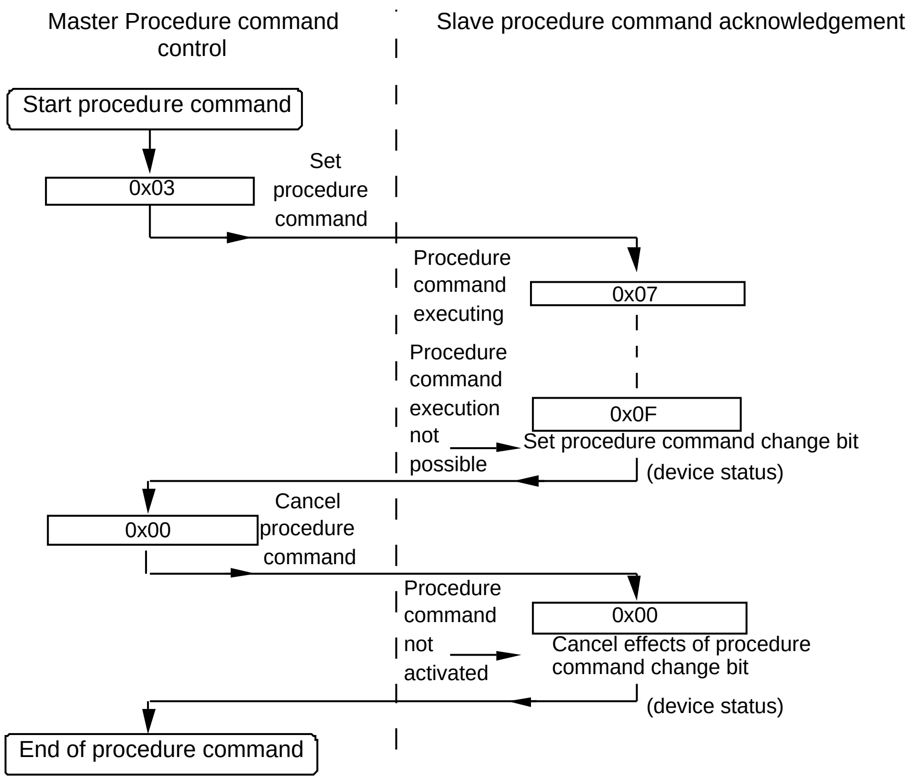

Figure 38 – Procedure command execution with error message

6.3 RT Channel

6.3.1 Introduction

Cyclic data is exchanged between all devices in a Type 19 network in communication phase CP4 according to the configuration given by the Initiate_cyclic_communication request (see 5.2).

6.3.2 Read_Cyclic (RDC)

Cyclic data is read by a DL user using the Read_Cyclic (RDC) request.

6.3.3 Write_Cyclic (WRC)

Cyclic data is written by a DL user using the Write_Cyclic (WRC) request. The cyclic data is transmitted in the next communication cycle of the Type 19 network.

6.3.4 Notify_Cyclic_Data (NCD)

Upon reception of a DLPDU of Type MDT0-MST the DL generates a Notify_Cyclic_Data (NCD) indication for the DL user.

6.4 Transmission and activation of Type 19 time

The Type 19 time is 8 octets long and is transmitted in fragments of 2 octets in the Extended field of MDT0. The fragmentation is controlled by 2 control bits (bits 31-30) in the Extended field and the Cycle CNT of MST. The Cycle CNT uses the bits 6-4 in MDT phase and bit 5 in MDT type. Each time fragment is transferred Initiate_cyclic_communication reqd in two consecutive communication cycles, therefore the transfer is tolerant of one telegram loss. The following sequence shall be handled by the master:

- Cycle CNT = 0 and 1: bits 0-15 of Type 19 time are transmitted in time fragment

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- Cycle CNT = 2 and 3: bits 16-31 of Type 19 time are transmitted in time fragment
- Cycle CNT = 4 and 5: bits 32-47 of Type 19 time are transmitted in time fragment
- Cycle CNT = 6 and 7: bits 48-63 of Type 19 time are transmitted in time fragment

The slave shall assemble all received time fragments to the Type 19 time, taking into account the 2 control bits and the Cycle CNT. If one time fragment is invalid or loss, then the slave shall discard all received time fragments. The slave shall wait to the next transmission of the Type 19 time.

Control bit - Time fragment valid

- If the Time fragment valid bit is set to 1 then the data in the field "Time fragments" are valid.
- The slave can use the time fragment only, if this bit is set to 1.
- The master shall set this bit to 1 only, when the Cycle CNT of MST is 0.
- The master may set the valid bit to 0 at any time.

Control bit - Activate time

- In a continuous transfer of time fragments this bit is toggled when the master has transmitted a new time
- The master shall toggle this bit only, when the Cycle CNT of MST is 0.
- The slave shall activate the Type 19 time if this bit has toggled.

Calculation of Time forecast in the master

The transfer and activation of the Type 19 time takes a certain delay time, therefore, the master sends a predicted time to the slave. The master stores this predicted time at start of communication cycle only if the Cycle CNT of MST is 0. The stored time is transmitted to the slaves (see Figure 39).

In the slaves the activation of the Type 19 time occurs at the synchronization reference time (TSref). For this reason the master shall add the time delay to TSref. The predicted time results in the following formula:

$$\text{TIME forecast} = \text{TIME current} + 8 \cdot t_{\text{Scyc}} + \text{Time delay}$$

NOTE Time delay is the time between the start of the communication cycle in the master and the time TSref in the slave.

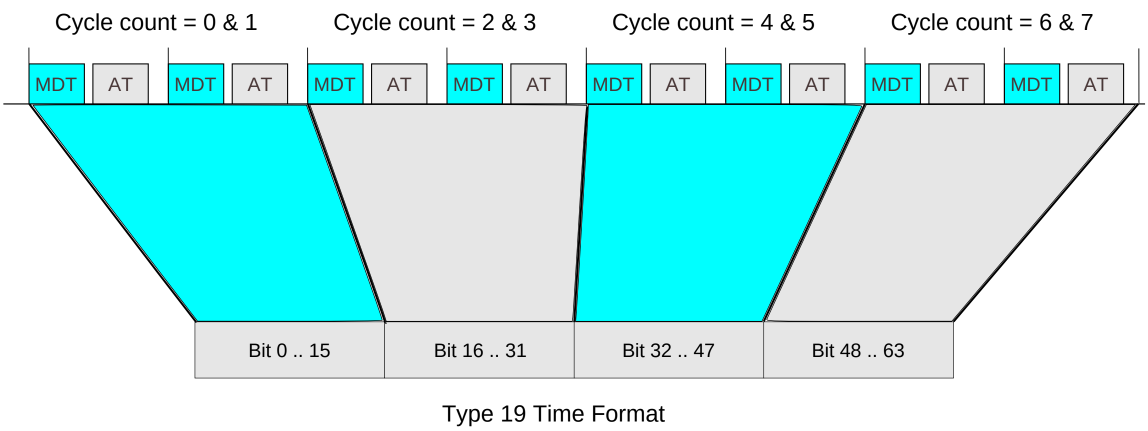

Figure 39 – Type 19 Time Transmission

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6.5 Multiplexing of real-time data with data containers

6.5.1 General

The multiplexing of parameters offers additional functions in the communication.

This means:

a) In the same place of the real-time data field different parameters may be transferred;
b) It is not necessary to change the telegram configuration by a new phase initialization;
c) The access of discrete list elements works by this procedure.

Multiplexing uses:

a) Parameters in form of containers, for transmitting different parameters;
b) Parameters in form of lists, for listing all parameters to be transmitted;
c) Parameters in form of pointers, to address the parameter which will be transmitted;
d) Parameters in form of indices, to address the list element which will be transmitted in case a list parameter is addressed.

For multiplexing there are two methods available:

a) Standard (standard data container)
b) Extended (extended data container)

This function group includes the following IDNs:

- S-0-0360 MDT data container A1
- S-0-0361 MDT data container B1
- S-0-0362 MDT data container A list index
- S-0-0363 MDT data container B list index
- S-0-0364 AT data container A1
- S-0-0365 AT data container B1
- S-0-0366 AT data container A list index
- S-0-0367 AT data container B list index
- S-0-0368 Data container A pointer
- S-0-0369 Data container B pointer
- S-0-0370 MDT data container A&B configuration list
- S-0-0371 AT data container A&B configuration list
- S-0-0444 IDN-list of configurable data in the AT data container
- S-0-0445 IDN-list of configurable data in the MDT data container
- S-0-0450 MDT data container A2
- S-0-0451 MDT data container A3
- S-0-0452 MDT data container A4
- S-0-0453 MDT data container A5
- S-0-0454 MDT data container A6
- S-0-0455 MDT data container A7
- S-0-0456 MDT data container A8
- S-0-0457 MDT data container A9

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- S-0-0458 MDT data container A10
- S-0-0459 MDT data container B2
- S-0-0480 AT data container A2
- S-0-0481 AT data container A3
- S-0-0482 AT data container A4
- S-0-0483 AT data container A5
- S-0-0484 AT data container A6
- S-0-0485 AT data container A7
- S-0-0486 AT data container A8
- S-0-0487 AT data container A9
- S-0-0488 AT data container A10
- S-0-0489 AT data container B2
- S-0-0490 MDT data container A2 configuration list
- S-0-0491 MDT data container A3 configuration list
- S-0-0492 MDT data container A4 configuration list
- S-0-0493 MDT data container A5 configuration list
- S-0-0494 MDT data container A6 configuration list
- S-0-0495 MDT data container A7 configuration list
- S-0-0496 MDT data container A8 configuration list
- S-0-0497 MDT data container A9 configuration list
- S-0-0498 MDT data container A10 configuration list
- S-0-0500 AT data container A2 configuration list
- S-0-0501 AT data container A3 configuration list
- S-0-0502 AT data container A4 configuration list
- S-0-0503 AT data container A5 configuration list
- S-0-0504 AT data container A6 configuration list
- S-0-0505 AT data container A7 configuration list
- S-0-0506 AT data container A8 configuration list
- S-0-0507 AT data container A9 configuration list
- S-0-0508 AT data container A10 configuration list

6.5.2 Functionality of standard data container

6.5.2.1 General

The standard data containers offer multiplexed switching between different real-time data in MDT and AT with a separate addressing mechanism.

In order to use this mechanism the standard data containers shall be configured in MDT and AT.

Via standard data containers it is possible to

a) exchange more application data in MDT and AT in spite of limited length of the connections;

b) access discrete list elements by means of the list index parameters of MDT and AT;

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c) transfer multiplexed application data in every communication cycle with a cycle time of tscyc * number of multiplex parameters by incrementing the addressing.

There are 2 data containers with 4 octets and 2 data containers with 8 octets length defined for MDT and AT.

6.5.2.2 Data containers (standard)

Several standard data container are defined for the MDT and AT, serving as placeholders. The contents of the data containers can be dynamically changed by the master as necessary.

The master writes parameters in the slave by using “MDT data containers”.

The master reads parameters from the slave by using “AT data containers”.

The specified “standard data containers“ are listed below:

- S-0-0360 MDT data container A1
- S-0-0457 MDT data container A9
- S-0-0361 MDT data container B1
- S-0-0459 MDT data container B2
- S-0-0364 AT data container A1
- S-0-0487 AT data container A9
- S-0-0365 AT data container B1
- S-0-0489 AT data container B2

For both the „MDT data containers“ and „AT data containers“ the combinations in Table 84 are allowed.

Table 84 – List of valid standard data container combinations

Short name	Length (octets)
A1	4
A9	8
A1 + B1	4 + 4
A9 + B1	8 + 4
A1 + B2	4 + 8
A9 + B2	8 + 8

As can be seen:

a) Maximum one "data container A" (A1 or A9) is allowed;
b) Maximum one "data container B" (B1 or B2) is allowed but only in addition to a "data container A".

The “MDT data container” combination is independent of the “AT data container” combination. Data containers shall be configured in CP2 only.

If a transmitted parameter is shorter than its data container, the parameter shall be placed to the lower part of the data container. In this case the higher part remains free respectively not valid.

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6.5.2.3 Configuration of standard data container

a) Configuration lists

   1) The S-0-0370 MDT data container A&B configuration list shall contain all configured parameters of the MDT data containers.

   2) The S-0-0371 AT data container A&B configuration list shall contain all configured parameters of the AT data containers.

   3) These two configuration lists are writable in CP2 only.

b) IDN-lists of configurable parameters

   1) All configurable parameters for the MDT data container may be stored in the S-0-0445 IDN-list of configurable data in the MDT data container.

   2) All configurable parameters for the AT data container may be stored in the S-0-0444 IDN-list of configurable data in the AT data container.

The following Parameters are defined:

- S-0-0370 MDT data container A&B configuration list
- S-0-0371 AT data container A&B configuration list
- S-0-0445 IDN-list of configurable data in the MDT data container
- S-0-0444 IDN-list of configurable data in the AT data container

6.5.2.4 Addressing of standard data container

The data container pointer is the offset, within the data container configuration list (S-0-0370 MDT data container A&B configuration list and S-0-0371 AT data container A&B configuration list) from the start of the configuration list to the desired IDN. The master places the desired parameter in the MDT data container, while the slave places the desired parameter in the AT data container.

- Data container A pointer (S-0-0368) and
- Data container B pointer (S-0-0369) are specified.

Each data container pointer contains two 8-bit pointers.

- One 8-bit pointer addresses the IDNs in the MDT data container A&B configuration list (S-0-0370). The parameter of the selected IDN shall be placed in the MDT data container.
- The other 8-bit pointer addresses the IDNs in the AT data container A&B configuration list (S-0-0371). The parameter of the selected IDN shall be placed in the AT data container.

The data container pointers (S-0-0368&S-0-0369) shall be configured in the MDT since the master commands the slave the interpretation of the data containers (see Figure 40). Thereby, a switching of the parameters in the data container during a communication cycle is possible.

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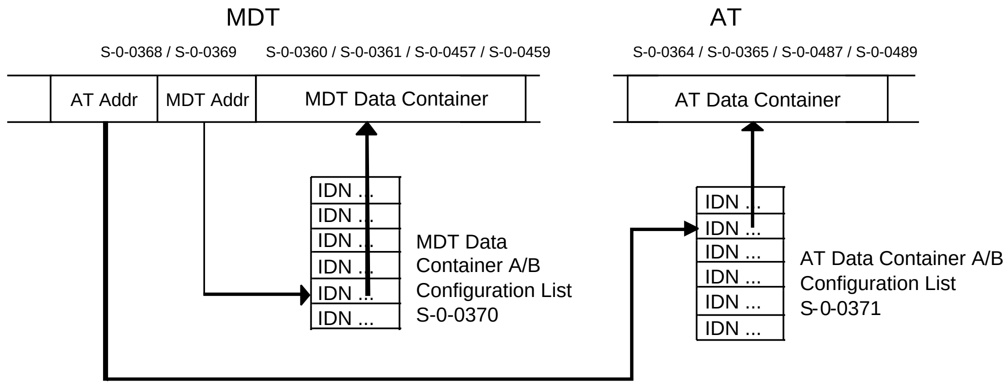

Figure 40 – Data container configuration without acknowledge (slave)

6.5.2.5 Acknowledgment of standard data containers

If the master requires an acknowledgment of the data container transmission, then it has 2 possibilities.

- To configure the identical data container pointer as well in the AT.
- To read the identical data container pointer via the SVC.

The slave shall generate the acknowledgment by copying the data container pointer of MDT to the AT.

The slave shall acknowledge the 8-bit pointer in the AT with the value 255 (not valid) if

- the pointer is situated outside of the configuration lists for the MDT or AT data container or
- the parameter is greater than the data container.

In this case the master and the slave shall ignore the corresponding data container (see Figure 41).

The master shall compare the data container pointer (S-0-0368&S-0-0369) of MDT and AT. If the result is equal, then the slave accepted the data in the MDT data container or wrote the requested data into the AT data container.

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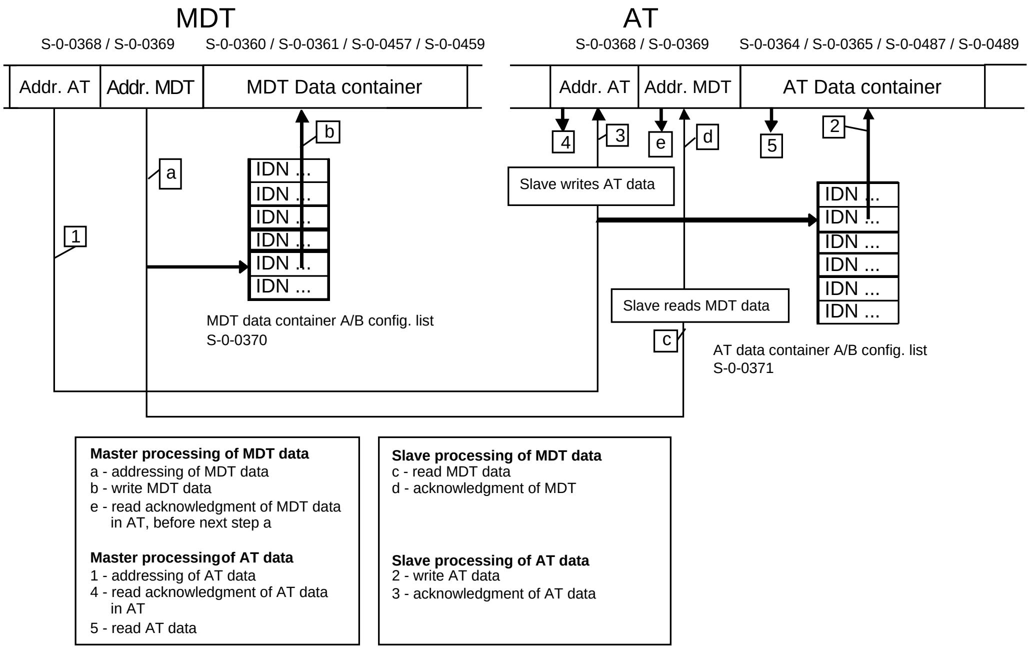

Figure 41 – Data container configuration with acknowledge (slave)

6.5.2.6 Addressing with list index (parameter lists)

If at least one parameter with „variable length“ (i.e. list parameter) has been programmed inside the “data container A/B configuration list“, this data would be too long for a data container. In this case

a) the corresponding list element will be addressed via the list index, therefore

b) the length of the list parameter shall not be changed.

There are 4 data container list indices specified, one for each data container:

a) IDN S-0-0362 MDT data container A list index;

b) IDN S-0-0363 MDT data container B list index;

c) IDN S-0-0366 AT data container A list index;

d) IDN S-0-0367 AT data container B list index.

Every data container list index consists of a 16 bit address.

Data container list indices shall be configured in the MDT since the master commands the slave the interpretation of the data containers. Thereby, a switching of the list elements in the data container during a communication cycle is possible.

Every data container list index consists of a 16 bit address.

Data container list indices shall be configured in the MDT since the master commands the slave the interpretation of the data containers. Thereby, a switching of the list elements in the data container during a communication cycle is possible.

If the master requires an acknowledgment of the data container transmission, then it has two possibilities.

a) To configure the identical data container list index as well in the AT;

b) To read the identical data container list index via the SVC.

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The slave shall generate the acknowledgment by copying the data container list index of MDT to the AT.

The slave shall acknowledge the data container list index in the AT with the value 65 535 (not valid) if the data container list index is situated outside of the length of the list parameter. In this case the master and slave shall ignore the corresponding data container. Optionally the slave may acknowledge the corresponding data container pointer in the AT with the value 255 (not valid).

The master shall compare the data container list index of MDT and AT. If the result is equal, then the slave accepted the data in the MDT data container or wrote the requested data into the AT data container.

Figure 42 shows the processing of list elements via data containers with list index.

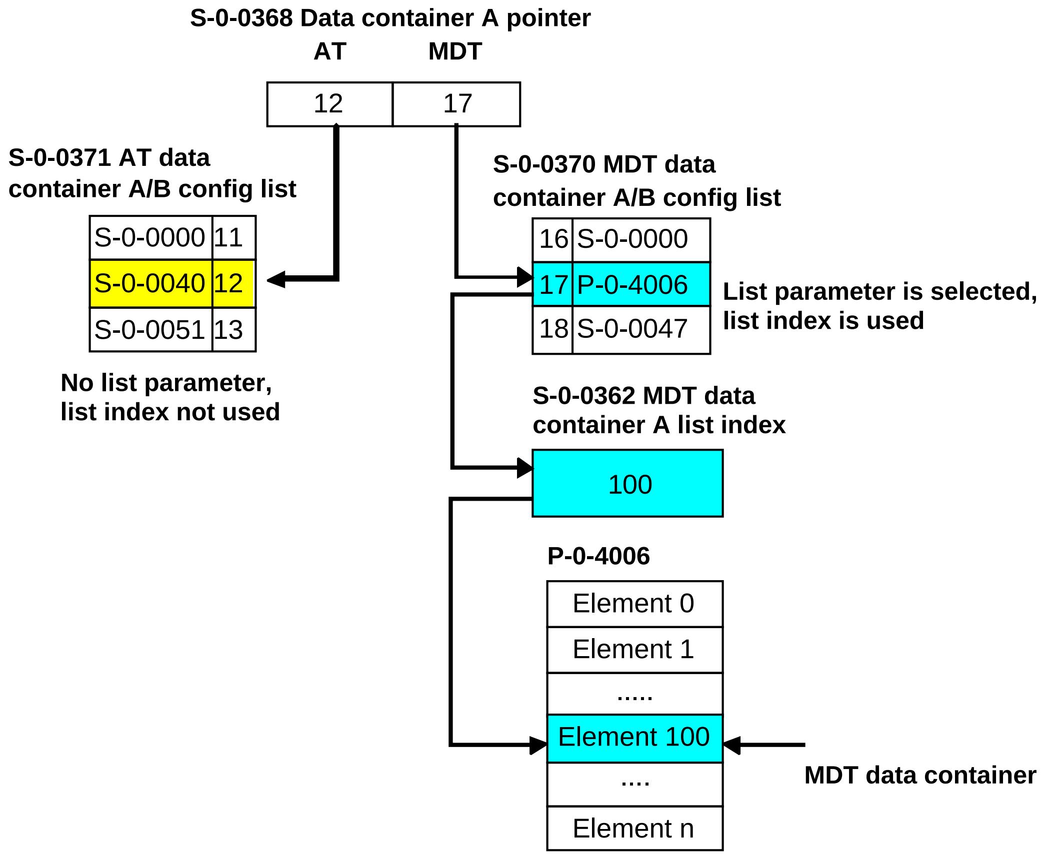

Figure 42 – Processing of list index in the MDT data

6.5.3 Functionality of extended data container (preferred function)

6.5.3.1 General

The extended data container offers multiplexed switching between different application data in MDT and AT with a common addressing mechanism.

In order to use this mechanism the data containers should be configured in MDT and AT.

Via extended data containers it is possible to

a) exchange more data in MDT and AT in spite of limited length of the connections;

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b) access discrete list elements by means of list index parameters of MDT and AT;

c) transfer multiplexed application data in every communication cycle with a cycle time of tscyc * number of multiplex levels by incrementing the addressing.

There are 8 data containers with 4 octets and 2 data containers with 8 octets length defined for MDT and AT.

6.5.3.2 Data containers (extended)

There are 10 data containers defined for the MDT and another 10 for the AT, serving as placeholders. The contents of the data containers can be dynamically changed by the master as necessary.

The master writes parameters in the slave by using “MDT data containers”.

The master reads parameters from the slave by using “AT data containers”.

The specified “extended data containers“ are listed below:

a) MDT data container
   1) IDN S-0-0360 MDT data container A1
   2) IDN S-0-0450 MDT data container A2
   3) IDN S-0-0451 MDT data container A3
   4) IDN S-0-0452 MDT data container A4
   5) IDN S-0-0453 MDT data container A5
   6) IDN S-0-0454 MDT data container A6
   7) IDN S-0-0455 MDT data container A7
   8) IDN S-0-0456 MDT data container A8
   9) IDN S-0-0457 MDT data container A9
   10) IDN S-0-0458 MDT data container A10

b) AT data container
   1) IDN S-0-0364 AT data container A1
   2) IDN S-0-0480 AT data container A2
   3) IDN S-0-0481 AT data container A3
   4) IDN S-0-0482 AT data container A4
   5) IDN S-0-0483 AT data container A5
   6) IDN S-0-0484 AT data container A6
   7) IDN S-0-0485 AT data container A7
   8) IDN S-0-0486 AT data container A8
   9) IDN S-0-0487 AT data container A9
   10) IDN S-0-0488 AT data container A10

Any combination of "MDT data container" may be selected for the MDT. Any combination of "AT data container" may be selected for the AT.

Data containers shall be configured in CP2 only.

If a transmitted parameter is shorter than its data container, the parameter shall be placed to the lower part of the data container. In this case the higher part remains free respectively not valid.

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6.5.3.3 Configuration of extended data container

a) Configuration lists (general)

   1) Each MDT data container and AT data container corresponds exclusively with its data container configuration list.

   2) The configuration lists can be written in CP2 only.

b) Configuration lists (MDT)

   1) All used MDT data container configuration lists shall have the same length.

   2) Unused list elements shall be programmed with IDN S-0-0000.

   3) If parameters of "variable length" (i.e. list parameter) are programmed in a MDT data container configuration list, then these list parameters shall have the same length.

c) Configuration lists (AT)

   1) All used AT data container configuration lists shall have the same length.

   2) Unused list elements shall be programmed with IDN S-0-0000.

   3) If parameters of "variable length" (i.e. list parameter) are programmed in a AT data container configuration list, then these list parameters shall have the same length.

d) Configurable parameters

   1) All configurable parameters for the MDT data container are optionally stored in the IDN lists of configurable data (IDN S-0-0445).

   2) All configurable parameters for the AT data container are optionally stored in the IDN lists of configurable data (IDN S-0-0444).

During procedure command "CP3 transition check" (IDN S-0-0127) the slave may check the mentioned restrictions about same length of list parameters. In case of a negative result the procedure command generates the error code in the diagnostic number (IDN S-0-0390).

All configuration lists of extended data container are listed below:

a) MDT data container configuration lists

   1) IDN S-0-0370 MDT data container A/B configuration list
   2) IDN S-0-0490 MDT data container A2 configuration list
   3) IDN S-0-0491 MDT data container A3 configuration list
   4) IDN S-0-0492 MDT data container A4 configuration list
   5) IDN S-0-0493 MDT data container A5 configuration list
   6) IDN S-0-0494 MDT data container A6 configuration list
   7) IDN S-0-0495 MDT data container A7 configuration list
   8) IDN S-0-0496 MDT data container A8 configuration list
   9) IDN S-0-0497 MDT data container A9 configuration list
   10) IDN S-0-0498 MDT data container A10 configuration list

b) AT data container configuration lists

   1) IDN S-0-0371 AT data container A/B configuration list
   2) IDN S-0-0500 AT data container A2 configuration list
   3) IDN S-0-0501 AT data container A3 configuration list
   4) IDN S-0-0502 AT data container A4 configuration list
   5) IDN S-0-0503 AT data container A5 configuration list
   6) IDN S-0-0504 AT data container A6 configuration list
   7) IDN S-0-0505 AT data container A7 configuration list
   8) IDN S-0-0506 AT data container A8 configuration list

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9) IDN S-0-0507 AT data container A9 configuration list

10) IDN S-0-0508 AT data container A10 configuration list

c) IDN lists of configurable data

1) IDN S-0-0445 IDN list of configurable data in the MDT data container

2) IDN S-0-0444 IDN list of configurable data in the AT data container

6.5.3.4 Addressing of extended data container

The data container pointer is the offset, within all used data container configuration lists from the start of the configuration list to the desired IDN. The master places the desired parameter in the MDT data container, while the slave places the desired parameter in the AT data container.

Only the Data container A pointer (IDN S-0-0368) is required and it applies to any data container.

The data container A pointer contain two 8-bit pointers.

- One 8-bit pointer addresses the IDNs in the MDT data container configuration lists (IDN S-0-0370, IDN S-0-0490 to IDN S-0-0498). The parameter of the selected IDN shall be placed in the MDT data container.
- The other 8-bit pointer addresses the IDNs in the AT data container configuration lists (IDN S-0-0371, IDN S-0-0500 to IDN S-0-0508). The parameter of the selected IDN shall be placed in the AT data container.

The data container A pointer (IDN S-0-0368) shall be configured in the MDT since the master commands the slave the interpretation of the data containers.

Figure 43 shows an example of configuration lists with a number of 32 levels.

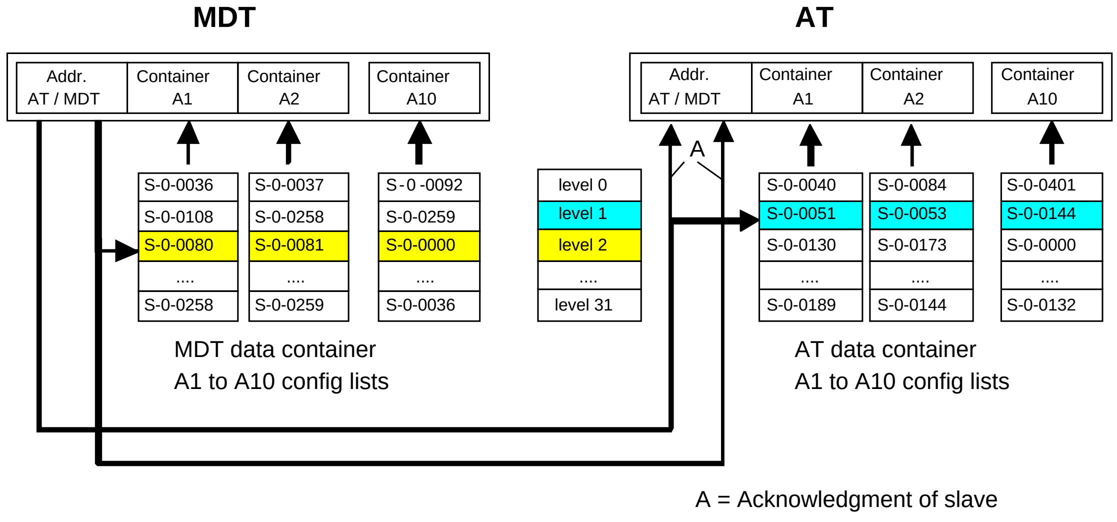

Figure 43 – Structure of extended data container

6.5.3.5 Acknowledgment of extended data container

If the master requires an acknowledgment of the data container transmission, then it has 2 possibilities.

- To configure the data container A pointer as well in the AT;
- To read the data container A pointer via the SVC.

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The slave shall generate the acknowledgment by copying the data container A pointer of MDT to the AT.

The slave shall acknowledge the 8-bit pointer in the AT with the value 255 (not valid) if

- the pointer is situated outside of the configuration lists for the MDT or AT data container or
- the parameter is greater than the data container.

In this case the master and the slave shall ignore all data containers for which the 8-bit pointer is responsible.

The master shall compare the data container A pointer (IDN S-0-0368) of MDT and AT. If the result is equal, then the slave accepted the data in the MDT data container or wrote the requested data into the AT data container.

6.5.3.6 Addressing with list index

If at least one parameter with „variable length“ (i.e. list parameter) has been programmed inside the “data container configuration list“, this data would be too long for a data container. In this case

- the corresponding list element will be addressed via the list index, therefore
- the length of the list parameter shall not be changed and
- the length of all selected list parameter shall have the same length.

There are 2 data container list indices specified:

- the MDT data container A list index (IDN S-0-0362) for all MDT data containers
- the AT data container A list index (IDN S-0-0366) for all AT data containers

Every data container list index consists of a 16 bit address.

The data container A list index shall be configured in the MDT since the master commands the slave the interpretation of the data containers. Thereby, a switching of the list elements in the data container during a communication cycle is possible.

If the master requires an acknowledgment of the data container transmission, then it has 2 possibilities.

- To configure the identical data container list index as well in the AT.
- To read the identical data container list index via the SVC.

The slave shall generate the acknowledgment by copying the data container list index of MDT to the AT.

The slave shall acknowledge the data container list index in the AT with the value 65535 (not valid) if the data container list index is situated outside of the length of one of the selected list parameters. In this case the master and slave shall ignore all corresponding data containers. Optionally the slave may acknowledge the corresponding data container pointer in the AT with the value 255 (not valid).

The master shall compare the data container list index of MDT and AT. If the result is equal, then the slave accepted the data in the MDT data container or wrote the requested data into the AT data container.

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6.5.4 Data container diagnostic

The parameters in the data containers are checked during initialization as well as during operation in CP4. If a slave detects an error in the data container it generates the corresponding diagnostic message.

- Data not configurable: IDN cannot be configured in MDT or AT data container. It has to ensured that the IDNs in the configuration lists can be transmitted as cyclic data. The slave checks it with procedure command IDN S-0-0127.
- Invalid addressing: In CP4 the slave checks whether the addressing is outside of the configuration lists. In the case of error the appropriate addressing in AT is set to 255. The contents of the data containers are invalid. Therefore all configuration lists shall be programmed with the same length. Unused list elements have to be programmed with IDN S-0-0000.

In CP4 the slave checks whether the list index is outside of the list parameter. In in the case of error the appropriate list index is set to 65535. Optionally the appropriate addressing in AT is set to 255. Therefore all list parameters shall be programmed with the same length. Unused list elements have to be set to 0x0.

- If the addressing of the MDT data container is invalid, then the slave may set S-0-0390 Diagnostic number to 0xC30E0008.
- If the addressing of the AT data container is invalid, then the slave may set S-0-0390 Diagnostic number to 0xC30E0009.

6.6 Handling of Real-time bits

6.6.1 General

The function group Real-Time bits (FG RTB) contains 3 options to exchange real-time bits (for example signals or events) between Type 19 nodes.

- Option 1: Two real-time bits are defined in the connection control. These are part of the application data.
- Option 2: One RTB word container as producer and one as consumer.
- Option 3: One RTB list container as producer and one as consumer.

Real-time bits in the consuming connection are distinguished from real-time bits in the producing connection. All logical assignments shall be IDNs of binary operation data (for example, level of switching signals, bits etc.).

The master shall assign IDNs only, which are supported by the slave in the "IDN list of configurable real-time bits".

Any real-time bits activated through these assignments maintain their meaning until the master overwrites or erases them with S-0-0000 or until another IDN changes the logical assignment.

When there is a write access over the service channel to the operation data of an IDN which is assigned to a real-time bit, the slave generates the error message „operation data is write protected, it is configured cyclically (error code 0x700A)“ via the service channel.

This function group includes the following IDNs:

- S-0-0026 IDN allocation of producer RTB word container
- S-0-0027 IDN allocation of consumer RTB word container
- S-0-0144 Producer RTB word container
- S-0-0145 Consumer RTB word container

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- S-0-0328 Bit allocation of producer RTB word container
- S-0-0329 Bit allocation of consumer RTB word container
- S-0-0398 IDN list of configurable real-time bits as producer
- S-0-0399 IDN list of configurable real-time bits as consumer
- S-0-1050.x.20 IDN Allocation of real-time bit
- S-0-1050.x.21 Bit allocation of real-time bit
- S-0-1080.x.02 Producer RTB list container
- S-0-1080.x.03 IDN allocation of producer RTB list container
- S-0-1080.x.04 Bit allocation of producer RTB list container
- S-0-1081.x.02 Consumer RTB list container
- S-0-1081.x.03 IDN allocation of consumer RTB list container
- S-0-1081.x.04 Bit allocation of consumer RTB list container

And the following Control and Status Bits

- C-CON/Real-time bit 1
- C-CON/Real-time bit 2

6.6.2 Real-time bits (RTB)

Two real-time bits are defined in the connection control (C-CON), which may be used with special assignments. Assignments are transmitted on demand via the service channel. The real-time bits are signals which indicate some selected status or event (for example, level of switching signals, bits etc.) in the master or the slaves. This status or event from the producer to the consumers is represented in real-time.

The consumer shall evaluate the real-time bits in the connection control only, if the monitoring of the connection mechanism was correct.

Real-time bits are assigned a logic meaning by means of the following assignments:

- The master uses assignment S-0-1050.x.20 and S-0-1050.x.21 to inform the producer and consumer which logical value is assigned to real-time bit 1 or real-time bit 2 in the connection control.
- For real-time bit 1 the master shall configure list element 0 of S-0-1050.x.20 and S-0-1050.x.21.
- For real-time bit 2 the master shall configure list element 1 of S-0-1050.x.20 and S-0-1050.x.21.
- The real-time bits shall be always write protected in a producing connection.

For using the real-time bits the following parameters are available:

- C-CON/Real-time bit 1
- C-CON/Real-time bit 2
- S-0-0398 IDN list of configurable real-time bits as producer
- S-0-0399 IDN list of configurable real-time bits as consumer
- S-0-1050.x.20 IDN Allocation of real-time bit
- S-0-1050.x.21 Bit allocation of real-time bit

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6.6.3 RTB word container

Real-time bits (for example signals or events) can be exchanged between Type 19 nodes by means of the RTB word container (see S-0-0144 and S-0-0145). For this purpose, the RTB word container needs to be integrated in a producing and/or consuming connection. Bits in the RTB word container are definable by means of the IDN allocation of RTB word container (see S-0-0026 and S-0-0027) and of the Bit allocation of RTB word container (see S-0-0328 and S-0-0329).

The sequence of the IDNs in the IDN allocation determines the bit numbering scheme in the RTB word container. The first IDN (list element 0) of the IDN allocation defines bit 0, the last IDN (list element 15) defines bit 15 of the RTB word container. The Bit allocation defines for each allocated IDN which bit is used. If the Bit allocation is not supported by the slave, the bit 0 of the allocated IDN is configured automatically.

The example in Table 85 shows the allocation of IDNs and bits of the producer RTB container.

The RTB word container has a length of 2 octets and shall be always write protected in a producing connection.

For using the RTB word container the following parameters are available:

RTB word container in producing connection

- S-0-0026 IDN allocation of producer RTB word container
- S-0-0144 Producer RTB word container
- S-0-0328 Bit allocation of producer RTB word container
- S-0-0398 IDN list of configurable real-time bits as producer

RTB word container in consuming connection

- S-0-0027 IDN allocation of consumer RTB word container
- S-0-0145 Consumer RTB word container
- S-0-0329 Bit allocation of consumer RTB word container
- S-0-0399 IDN list of configurable real-time bits as consumer

6.6.4 RTB list container

Real-time bits (for example signals or events) can be exchanged between Type 19 nodes by means of the RTB list container (see S-0-1080.x.02 and S-0-1081.x.02). For this purpose, the RTB list container needs to be integrated in a producing and/or consuming connection. Bits in the RTB list container are definable by means of the IDN allocation of RTB list container (see S-0-1080.x.03 and S-0-1081.x.03) and of the Bit allocation of RTB list container (see S-0-1080.x.04 and S-0-1081.x.04).

The sequence of the IDNs in the IDN allocation determines the bit numbering scheme in the RTB list container. The first IDN (list element 0) of the IDN allocation defines bit 0, the last IDN (list element n) defines the bit (n) of the RTB list container. The Bit allocation defines for each allocated IDN which bit is used.

The example in Table 85 shows the allocation of IDNs and bits of a producer RTB container.

The RTB list container shall have a variable length with an even number of octets and shall be always write protected in a producing connection.

For using the RTB list container the following parameters are available:

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RTB list container in producing connection

- S-0-0398 IDN list of configurable real-time bits as producer
- S-0-1080.x.02 Producer RTB list container
- S-0-1080.x.03 IDN allocation of producer RTB list container
- S-0-1080.x.04 Bit allocation of producer RTB list container

RTB list container in consuming connection

- S-0-0399 IDN list of configurable real-time bits as consumer
- S-0-1081.x.02 Consumer RTB list container
- S-0-1081.x.03 IDN allocation of consumer RTB list container
- S-0-1081.x.04 Bit allocation of consumer RTB list container

Table 85 – Example of IDN and bit allocation of RTB container

Bit number of RTB container	Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8	etc.
IDN allocation	S-0-0403	S-0-0013	S-0-0000	S-0-0013	S-0-0013	S-0-0012	S-0-0330	S-0-0403	S-0-0012	…
Bit allocation	0	5	x	9	0	4	0	1	1	…

NOTE RTB container Bit 0: Bit 0 of S-0-0403 is assigned. RTB container Bit 1: Bit 5 of S-0-0013 is assigned. RTB container Bit 2: is not used. RTB container Bit 3: Bit 9 of S-0-0013 is assigned. etc.

6.7 SMP

6.7.1 Definitions

The Type 19 Messaging Protocol uses the S-0-1101.x.01 SMP Container Data to transmit SMP messages or SMP fragments. The length of the SMP container may be between 4 and 258 octets without any restriction. The SMP container shall be configured in a connection. Therefore, the connection length shall be equal or greater than the SMP container. Two formats are defined for the SMP message resp. SMP fragment, these are the regular format and extended format. These two formats are selected with the EXTF bit in the Session Control Header. The length of SMP container is defined by the current length of S-0-1101.x.01.

Figure 44 shows the two structures of the SMP container.

- Regular format contains the session control header (2 octets) and the application data. The size of the application data may be configured between 2 octets and 256 octets. The size of application data is not changeable.
- Extended format contains the session control header and can be filled only partially with application data. The extended size of the transmitted application data is indicated in the last octet of the SMP container. Extended sizes of application data are changeable between 0 octet and 255 octets in every transmission. If the extended size is 0, then the consumer shall evaluate the session control header only.

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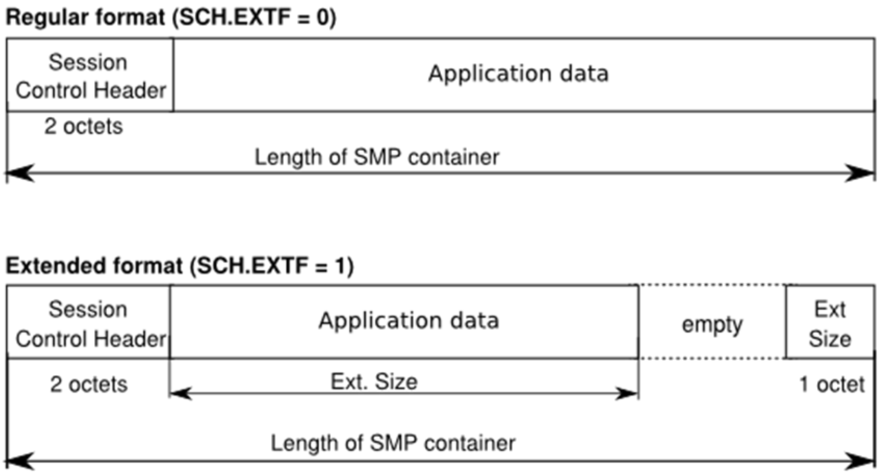

Figure 44 – Transport container

NOTE Length of SMP container = current length of S-0-1101.x.01 SMP Container Data (4...258 octets)

6.7.2 Structure of the Session Control Header (SCH)

The Session Control Header controls

- the fragmentation of SMP messages which are larger than the SMP containers used,
- the prioritization of SMP messages, and
- multiplexing several logic sessions through a single SMP container.

Its structure is as shown in Table 86.

Table 86 – Structure of the Session Control Header

Bit number	Value	Description
15-8	—	Session identifier (SID) Up to 255 sessions can be transmitted via a SMP container. The Session Identifier indicates the session of a SMP message for which the application data are intended.
	0-254	Valid values for the SID (0x00–0xFE)
	255	The value 255 (0xFF) is reserved for services of the transport layer
7	—	Last of Sequence (LOS): The received SMP container transported the last SMP fragment of a session sequence. The bits LOS & FOS controls the fragmentation of SMP messages that exceed the size of the SMP container.
	0	SMP fragment of a session
	1	last SMP fragment of a session
6	—	First of Sequence (FOS): The received SMP container

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Bit number	Value	Description
		transported the first SMP fragment of a session sequence. All SMP fragments so far received on this priority level of this SMP container and not yet completed by a LOS are discarded. The bits LOS & FOS controls the fragmentation of SMP messages that exceed the size of the SMP container.
	0	SMP fragment of a session
	1	first SMP fragment of a session
5-4	—	Sequence Counter (SC) The sequence counter is managed separately for each session. It is incremented for every SMP fragment or SMP message transmitted within a session. The SC uncovers transmission failures that occurred within a fragmented SMP message.
	0-3	Sequence Counter value
3-2	—	Priority (PRI) Corresponds to the priority of the session through which this SMP message is sent. In accordance with this bit field, the transport layer can give high-priority SMP messages (for example cyclical data) preferential treatment in contrast to less time-critical SMP messages (for example non-cyclical configuration services).
	00	Priority 0 (highest level)
	01	Priority 1
	10	Priority 2
	11	Priority 3 (lowest level)
1	—	Extended format (EXTF) This bit indicates that the SMP container is not filled completely. In this case, the number of actually contained application data is entered in the last octet of the SMP container.
	0	Regular format: SMP container is filled completely
	1	Extended format: SMP container not filled completely. The consumer shall evaluate the extended size (last octet of SMP container).
0	Toggle	New Data Toggle (NDT) This bit indicates that the contents of the SMP container (i.e. the Session Control Header or the application

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Bit number	Value	Description
		data) have been changed. The consumer needs to evaluate the SMP container only if the status of this bit has been toggled.
	0/1	Current value

6.7.3 Evaluation sequence of session control header by the consumer

The consumer shall evaluate the SMP message in a defined sequence as follows:

- The consumer shall check the New data toggle (NDT).
  - If it has toggled (NDT != int.NDT), then a new SMP fragment has been received. The consumer shall continue to evaluate the SMP fragment and shall change its expectation. Therefore, it shall toggle its internal bit "int.NDT".
- The consumer shall check the configuration of the received SID in S-0-1101.x.02 List of session identifiers.
  - If the SID is configured, then the consumer shall continue to evaluate the SMP fragment.
  - Otherwise, the consumer cancels the evaluation.
- The consumer shall check the configuration of the received PRI in S-0-1101.x.03 List of session priorities.
  - If the PRI is configured and corresponds to the SID, then the consumer shall continue to evaluate the SMP fragment.
  - Otherwise, the consumer cancels the evaluation.
- The consumer shall check the FOS.
  - If the FOS is set to 1, then the consumer shall reset the SMP fragment buffer of the received priority.
  - The consumer stores the received SMP fragment in the corresponding buffer of the priority.
  - The consumer shall set the received SC to its internal SC to generate an expectation for the next SMP fragment.
- If the FOS is set to 0, and the received SMP fragment is not the first, then the SC shall be checked with the internal SC.
  - If the check of SC is valid, then the consumer stores the received SMP fragment in the corresponding buffer of the priority.
  - If the check of SC is invalid, then consumer cancels the evaluation and the SMP fragment is discarded.
- If the FOS is set to 0, and the received SMP fragment is the first, then the consumer cancels the evaluation and the SMP fragment is discarded.
- If the SMP fragment has been stored and the LOS is 1, then the consumer shall assemble all stored SMP fragments of the buffer to a SMP message and pass it on to the application.

6.7.4 Multiplexing of two sessions (example)

Figure 45 shows an example for the transmission of two sessions through a transport container of a length of 10 octets. In the first session (SID 0x7), 8 octets of "application data A" are transmitted. The second session (SID 0x3) is used to transmit "application data B" with a length of 24 octets. The "application data B" are divided into three SMP fragments of 8 octets each. The example shows how the fragmentation is controlled by means of the FOS and LOS bits. The consumer stores the received SMP fragments in a fragment buffer until a Last-of-Sequence-Fragment (LOS = 1) is received. Independent of the currently transmitted

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session, the NDT bit toggles with each new SMP message. If no application data is ready for transmission in the producer, the NDT will not be toggled in the next SMP message. In this case, the consumer will not evaluate the other bits of the session control header and the application data of the SMP container. The SC is managed separately for each session and is incremented with every SMP message pertaining to a session. This assures that a low priority session can be interrupted by a session of higher priority. After the high-priority transmission is completed, the interrupted session will be resumed.

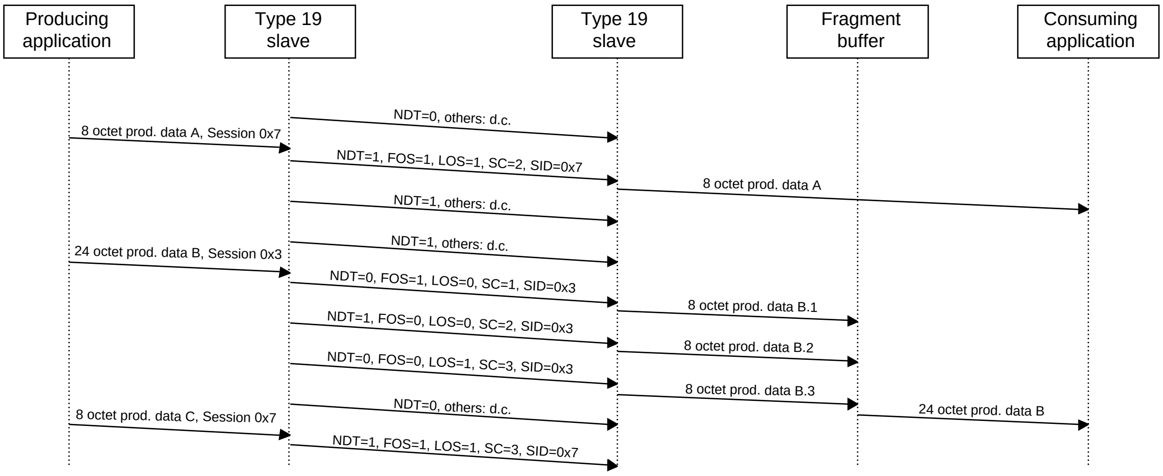

Figure 45 – UML Sequence Diagram: Multiplexing of two sessions (Example)

6.7.5 Priorization

The priority (PRI) field of the session control header controls the transmission order of SMP fragments. SMP fragments with a higher priority (lower value in the PRI field) shall be transmitted first. SMP fragments on the same priority level shall be transmitted in the same order as they were generated by SMP's session layer.

This prioritization scheme has the following characteristics:

- If a SMP message is to be sent while a transmission with lower priority is in progress, the low-priority SMP message will be interrupted. The higher-priority SMP message will be be sent first. After it is completed, the low-priority SMP message will be resumed.
- If an SMP message is to be sent while a transmission with equal or higher priority is in progress, the new SMP message is queued until all pending SMP messages of higher or equal priority have been transmitted.

One possible implementation would be a set of four FIFO queues (one for each priority level) that store the outgoing SMP fragments. When a new message is sent via SMP, the session layer will split the application data into SMP fragments. These SMP fragments are pushed to the end of the FIFO queue associated with the priority level of the sending session. Whenever a new SMP fragment can be sent, the SMP network layer will take the SMP fragment from the highest priority non-empty queue and copy it into the SMP container.

6.7.6 Diagnosis of SMP

Diagnosis information is collected centrally in parameter IDN S-0-1100 SMP Diagnosis. This diagnosis contains the following structure elements:

a) IDN S-0-1100.0.1 Diagnostic counter sent SMP fragments

b) IDN S-0-1100.0.2 Diagnostic counter received SMP fragments

c) IDN S-0-1100.0.3 Diagnostic counter discarded SMP fragments

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6.7.7 Definition of SMP containers

Parameter IDN S-0-1101 SMP Transport container is defined for the transport of SMP fragments through the SMP container. The structure of this container is defined by the following structure elements:

a) IDN S-0-1101.x.01 SMP container data

b) IDN S-0-1101.x.02 List of the session identifiers

c) IDN S-0-1101.x.03 List of the session priorities

The structure element IDN S-0-1101.x.1 is configured in a SMP container; thus, it contains the application data transmitted in this SMP container.

The other structure elements describe the sessions currently active for this SMP container.

The lists in IDN S-0-1101.x.2 and IDN S-0-1101.x.3 shall have the same actual length. List elements with identical index describe one session.

6.7.8 Example

In the following example, 3 sessions are active in the SMP container 7 (S-0-1101.7.01):

- Session 0x04, priority 0
- Session 0x05, priority 3
- Session 0xF3, priority 0

Table 87 – Lists in S−0−1101.7.x

Element	S-0-1101.7.2 List of session identifiers	S-0-1101.7.3 List of session priorities
Actual	6	6
Max	20	20
0	0x04	0
1	0x05	3
2	0xF3	0

6.8 Oversampling

6.8.1 Description

Oversampling is a method used to receive or send more information (samples) about a signal (inputs or outputs) between two (producer) cycles. N samples are transmitted together in one cycle, therefore requiring at least N times as much telegram space compared to the "normal" signal. The method can be used for inputs as well as for outputs.

6.8.2 General

Oversampling is described in this function group. There are two structured IDNs within this function group (see Figure 46).

- Configuration (S-0-1150): Holds all the Oversampling configurations.
- Capabilities(S-0-1151): Describes all of the parameters of this function group.

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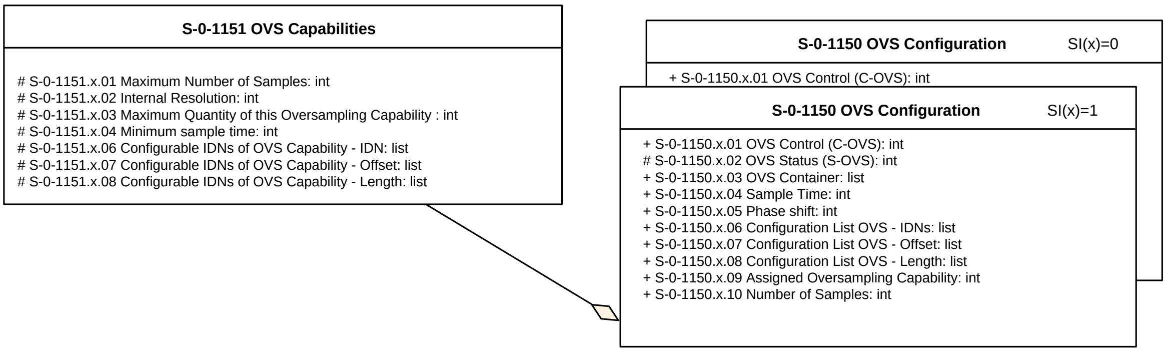

Figure 46 – Oversampling overview

6.8.3 Constraints

The following constraints shall be considered:

- The oversampling domain describes the set of IDNs which belong together, defining one oversampling machine.
- There is exact one oversampling clock for an oversampling domain.
- The sampling time is an integer fraction of the producer cycle time (for example Pcyc = 1 ms, sampling time = 50 µs).
- Sampling points are equidistant with respect to time.

6.8.4 Oversampling Input

One or several signals are sampled in a producer cycle (Pcyc) with a defined faster sample clock. The sampled values are combined in a so called oversampling container and transmitted in the following producer cycle. The last sampling point transmitted in one producer cycle is the sample of the respective T4pc.

Figure 47 shows an example with a tPcyc of 2 * tScyc and Oversampling factor of 8.

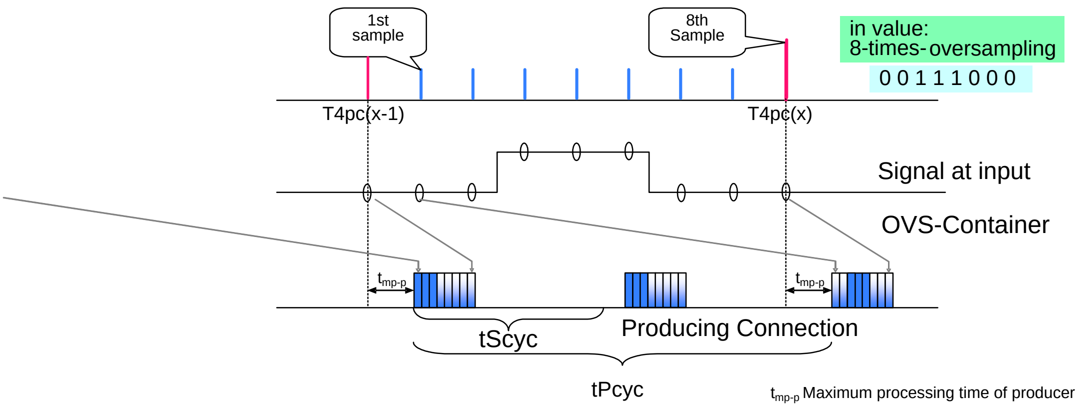

Figure 47 – Oversampling timing input (producer)

6.8.5 Oversampling Output

One or several signals are output within a producer cycle (Pcyc) with a defined faster sample clock. The values which are received get valid in the next producer cycle.

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Figure 48 shows an example with a tPcyc of 2 * tScyc and Oversampling factor of 8. The first sampling point gets valid at T4pc.

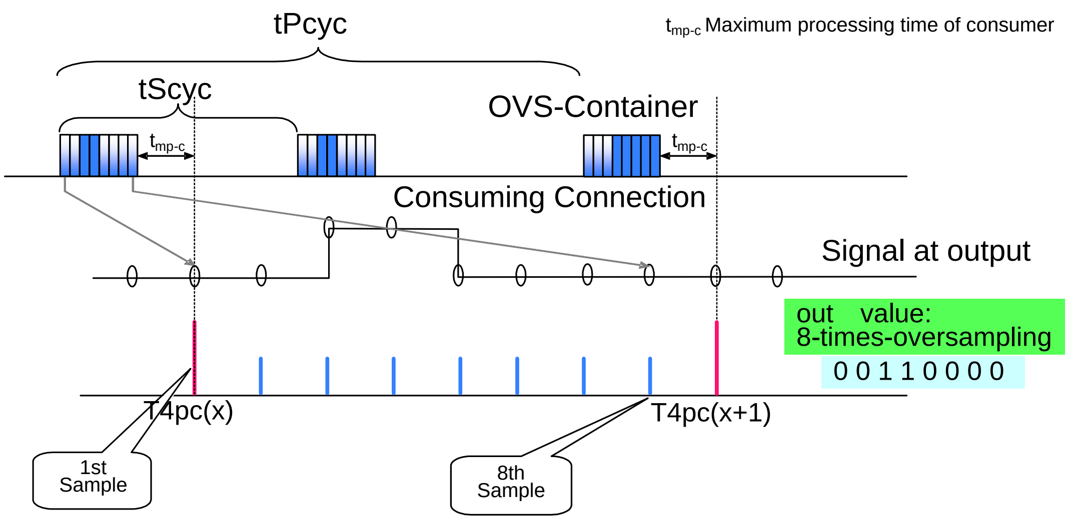

Figure 48 – Oversampling timing output (consumer)

6.8.6 Oversampling Identification

IDN S-0-1151 with its structure elements (SEs) defines the capabilities of the function group oversampling.

An oversampling domain is assigned to a structure instance. The available domains are shown in S-0-1152 Amount of OVS Domains.

- S-0-1151.x.01 Maximum number of samples
- S-0-1151.x.02 Internal resolution
- S-0-1151.x.03 Maximum quantity of this oversampling capability
- S-0-1151.x.04 Minimum sample time
- S-0-1151.x.06 Configurable IDNs of OVS capability
- S-0-1151.x.07 Configurable IDNs of OVS Capability - Offset
- S-0-1151.x.08 Configurable IDNs of OVS Capability - Length

All structure elements of parameter S-0-1151 are read only.

6.8.7 Oversampling Configuration

Each structure instance (SI) of IDN S-0-1150 contains the configuration of the corresponding oversampling domain.

S-0-1150.x.09 Assigned Oversampling Capability assigns the instance of the dedicated oversampling capability S-0-1151 OVS Capabilities.

The structure elements are:

- S-0-1150.x.01 OVS Control (C-OVS)
- S-0-1150.x.02 OVS Status (S-OVS)
- S-0-1150.x.03 OVS Container
- S-0-1150.x.04 Sample time

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- S-0-1150.x.05 Phase shift
- S-0-1150.x.06 Configuration List OVS - IDNs
- S-0-1150.x.07 Configuration List OVS - Offset
- S-0-1150.x.08 Configuration List OVS - Length
- S-0-1150.x.09 Assigned Oversampling Capability
- S-0-1150.x.10 Number of Samples

6.8.8 Application example

- Sampling of fast inputs (<tPcyc)
- Creating fast signal forms (<tPcyc) at an output

Relationship between S-0-1150.x.04 Sample time and S-0-1150.x.10 Number of Samples

The configuration of both IDNs can be performed in the following ways:

- If S-0-1150.x.10 Number of Samples is written, the operation data of S-0-1150.x.04 Sample time is calculated by the slave according to: S-0-1150.x.04 Sample time = S-0-1050.x.10 Producer Cycle Time / S-0-1150.x.10 Number of Samples.
- If S-0-1150.x.04 Sample time is written, the operation data of S-0-1150.x.10 Number of Samples is calculated by the slave according to: S-0-1150.x.10 Number of Samples = S-0-1050.x.10 Producer Cycle Time / S-0-1150.x.04 Sample time. If the result is not an integer in nanoseconds it is rounded.
- If the corresponding OVS container has not been configured in a connection (for example for OVS via SVC), no S-0-1050.x.10 is available, which can be used for the calculation of S-0-1150.x.04. In this case the configuration of the oversampling machine has to be done via S-0-1150.x.04 Sample time.

6.8.9 Oversampling State Machine

Figure 49 shows the state machine that shall be applied.

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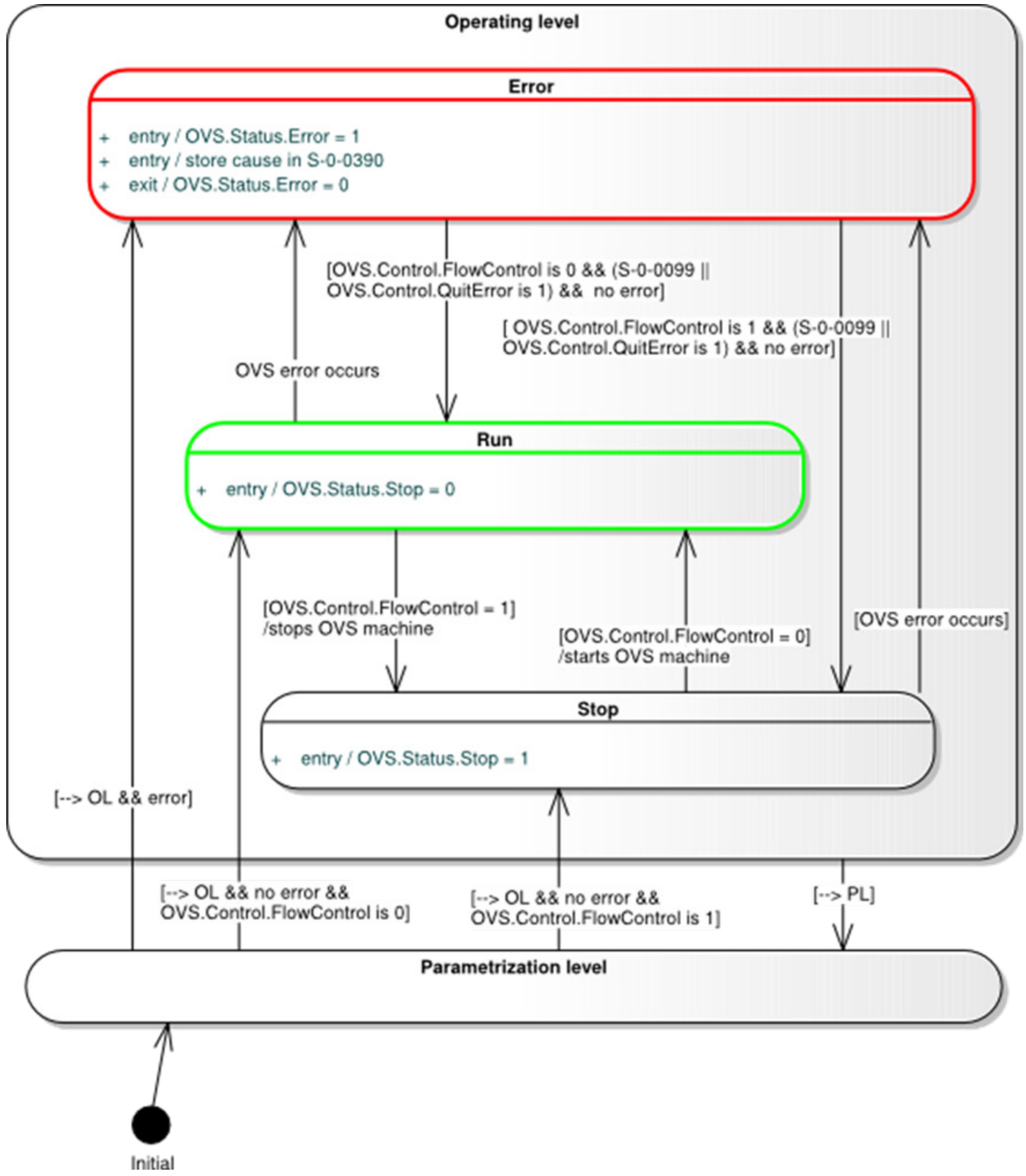

Figure 49 – Oversampling state machine

The states of the state machine are described in Table 88.

Table 88 – States of the oversampling state machine

State	Description
Run	In this state the OVS.Status.stop is set to 0. The oversampling state machine is ready-to-operate and remains in this state until it is stopped or an error occurs.
Stop	In the state stop the OVS mechanism is stopped and the OVS.Status.stop is set to 1. The input container contains the last valid samples (freeze). The output signals are frozen.
Error	If an error occurs the container values are invalid. The OVS.Status.Error is set to 1 in order to show this error. A diagnostic message 0xC30F4018. shall be generated using the appropriate diagnostic mechanisms (S-0-0390).

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The transitions of the state machine are described in Table 89.

Table 89 – Transitions of the oversampling state machine

Transition		Description
Source	Target	
Run	Stop	If the OVS.Control.FlowControl is 1, then the oversampling machine stops and switches to "Stop" state.
Run	Error	With the occurrence of an error the oversampling machine stops and switches to the "Error" state.
Stop	Run	If the OVS.Control.FlowControl is 0, then the oversampling machine starts and switches to "Run" state.
Stop	Error	With the occurrence of an error the oversampling machine switches to the "Error" state.
Error	Run	If OVS.Control.QuitError is 1 or the procedure command S-0-0099 is executed and OVS.Control.FlowControl is 0 and no error is present, then the oversampling machine starts again and switches to "Run" state.
Error	Stop	If OVS.Control.QuitError is 1 or the procedure command S-0-0099 is executed and OVS.Control.FlowControl is 1 and no error is present, then the oversampling machine switches to the "Stop" state.

7 Telegram timing and DLPDU handling

7.1 Communication mechanisms

7.1.1 Cycle time

The communication cycle time, tScyc, shall have one of the following values:

tScyc = 31,25 μs, 62,5 μs, 125 μs, 250 μs up to 65 ms (in 250 μs increments)

This cycle time may have some jitter. The jitter describes the deviations from the tScyc value in the distance between two MSTs.

Therefore, the actual time interval between the end of a MST and the end of the following MST shall have a

- minimum value of j x tScyc × 0,999 9 × JtScyc (j = 1, 2, 3, ...) and a
- maximum value of j x tScyc × 1,000 1 + JtScyc (j = 1, 2, 3, ...).

NOTE j is an ordinary integer and not related to the abbreviations.

The factors 0,999 9 and 1,000 1 take into account the deviation of the communication cycle time S-0-1002 (tScyc), compared to the accuracy of the usual crystal oscillators (±50 $\mu Hz/Hz$). The jitter shall not accumulate over several periods (i.e., the average value shall be zero).

7.1.2 Medium access

7.1.2.1 Definitions of the communication timing

The timing calculations of a Type 19 network are based on 100 Mbit/s transmission rate.

During the initialization, the master shall inquire for time parameters from the slaves, see Communication phase 2 (CP2). With this information, the master shall calculate collision-free transmission time-slots of the Type 19 telegrams within the RT channel.

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The master shall transmit to each slave the S-0-1006 AT0 transmission starting time (t1), as well as the beginning and end times of the UC channel, t6 and t7 (S-0-1017 UC transmission time) respectively. These starting times for the transmitting time-slots for the telegrams are defined below, whereas the jitters and delay times have been incorporated in this timing.

RT channel ≈ MDT block + AT block

For a collision-free communication during the RT channel the following parameters shall be taken into account when calculating the related timing by the master (see Table 90).

Table 90 – Parameter for timing calculation

Parameter	Description
TTref[ns]	In the following text, all timings refer to the "end of MST" called TTref (see Figure 50). It is defined as the last edge time of the MST-CRC.
tTH[ns]	The telegram header (tTH) defines the delay time from beginning of preamble to end of MST (TTref) and is a constant time of 2240 ns (28 octets).
MST jitter[ns]	Depending on the performance of the hardware, the master sends the MST (MDT block) with a jitter. The MST jitter is part of the S-0-1023 SYNC jitter.
t1 jitter[ns]	Depending on the performance of the hardware, the master sends the AT0 (AT block) with a jitter.
Slave jitter[ns]	The interface (hardware) of the slave produces the telegram jitter defined in S-0-1037 Slave Jitter.
Inter frame gap (IFG)[octets]	The IFG defines the distance between two Ethernet frames. The Ethernet specification requires 12 octets as a minimum. The inter frame gap is dependent on the number of participants in the topology. The formula of IFG shall be used by the master to calculate the S-0-1036 Inter Frame Gap for the given application.
tIFG[ns]	corresponds to the inter frame gap of octets converted into time (ns).
IFG jitter[ns]	corresponds to tIFG – 960 ns (12 octets). The IFG jitter is part of the S-0-1023 SYNC jitter.
MDT block[ns]	Period of all used MDTs with the corresponding inter frame gaps.
AT block[ns]	Period of all used ATs with the corresponding inter frame gaps.

The timing parameters of the communication shall be set by the master in CP2 and activated in the master and the slaves in CP3 and CP4.

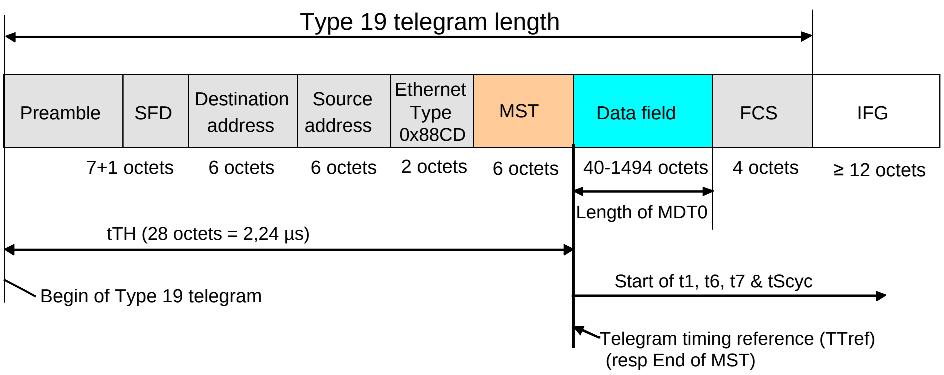

Figure 50 – Telegram timing reference

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7.1.3 Calculation of the Type 19 telegram length

The calculation of a Type 19 telegram length includes the following telegram fields shown in Figure 51:

- Preamble + SFD (7 + 1 octets)
- Destination address (6 octets)
- Source address (6 octets)
- Ethernet type (2 octets)
- Type 19 header (6 octets)
- Frame check sequence (4 octets)

--> The total header of a Type 19 telegram contain 32 octets.

- Data field (40 to 1494 octets)

Minimum and maximum telegram lengths and periods:

- The minimum telegram length of a Type 19 telegram contains 72 octets (32 octets + 40 octets) resulting in a telegram period of 5,8 µs.
- The maximum telegram length of a Type 19 telegram contains 1526 octets (32 octets + 1494 octets) resulting in a telegram period of 122,1 µs.

An individual SIII telegram period is calculated as follows:

- Type 19 telegram period (µs) = Type 19 telegram length (octets) * 8 (bit) * 0,01 (µs)

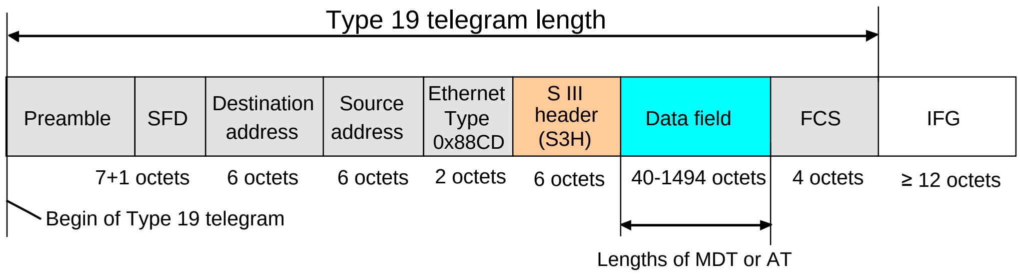

Figure 51 – Calculation of telegram length

7.1.4 Timing calculation of RT channel

At first the master shall calculate the time of the RT channel, then the master can calculate the time-slot of the UC channel.

The following calculations shall be done by the master:

- MDT block = sum of Type 19 telegram periods of all used MDTs + number of MDTs * tIFG (see S-0-1036 Inter Frame Gap).
- AT block = sum of Type 19 telegram periods of all used ATs + number of ATs * tIFG (see S-0-1036 Inter Frame Gap).
- with the given communication cycle time and the MDT block and AT block the master calculate the times t1min and t1max.
- the master shall determine the time t1 under consideration of t1min, t1max and tScyc.
- S-0-1006 AT0 transmission starting time (t1): this is the nominal time interval between the end of MST and the beginning of AT0. This parameter shall be determined by the master and stored in the associated slaves.

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- S-0-1017 NRT transmission time: beginning of UC channel (t6) and end of UC channel (t7). Within the UC channel there shall not be any special time-slots. Every participant shall be able to send its Ethernet frames during this time-slot.
- S-0-1023 SYNC jitter: is calculated by the master using the MST jitter and IFG jitter. This parameter is transmitted to the slaves in CP2.
- Formula of S-0-1036 Inter Frame Gap:

$$S-0-1036 \geq \frac{27*(S-0-1037)_{MAX}*\sqrt{2*N}}{8000}*\frac{1octet}{0{,}08\mu s}+12octets$$

NOTE N is the number of participants in the topology.

7.1.5 Calculation of S-0-1006 AT0 transmission starting time (t1)

The master shall calculate the minimum time of t1 (t1min) and the maximum time of t1 (t1max) under consideration of the S-0-1002 Communication Cycle time (tScyc).

- t1min = MDT block + (t1 jitter) - tTH
- t1max = tScyc - AT block - tTH - t1 jitter - (SYNC jitter)
- if t1max < t1min, then the master shall use a longer tScyc or reduce the amount of data in the Type 19 telegrams.
- t1min ≤ S-0-1006 ≤ t1max

Figure 52 shows the timing of t1 which is possible in CP3 and CP4.

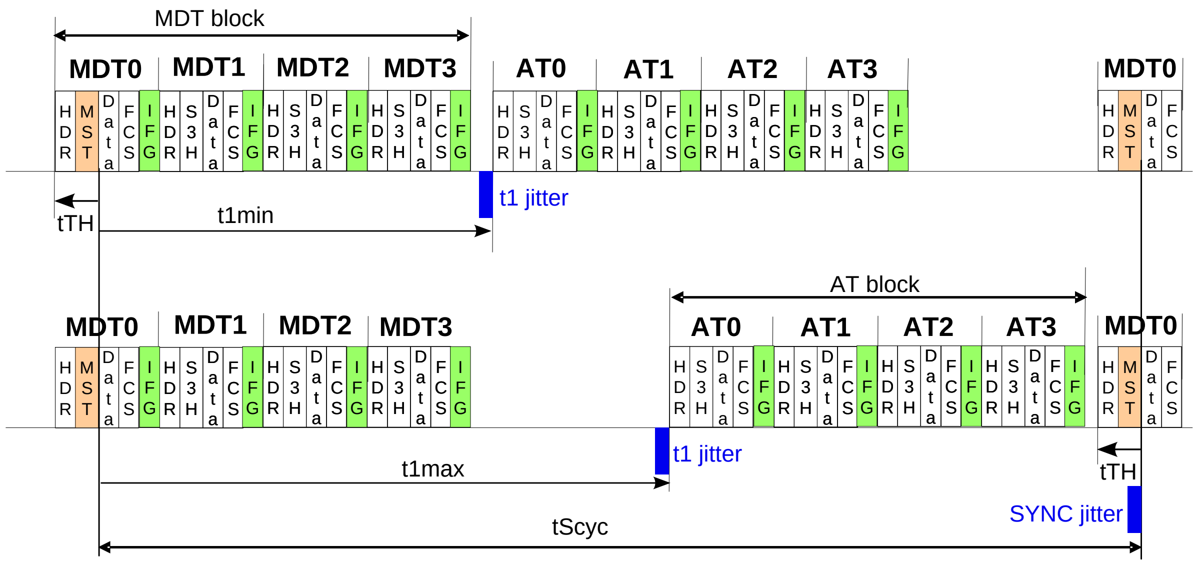

Figure 52 – Calculation of t1

NOTE

- t1 jitter = transmitting jitter of AT0
- MST jitter = transmitting jitter of MDT0
- Sync jitter = S-0-1023 SYNC jitter
- HDR = Ethernet header
- MST = Type 19 header of MDT0
- S3H = Type 19 header of MDT1 to MDT3 and AT0 to AT3
- Data = Payload
- FCS = Frame check sequence

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- IFG = S-0-1036 Inter Frame Gap
- tTH = Type 19 telegram header
- MDT block = Period of all transmitted MDTs
- AT block = Period of all transmitted ATs

7.1.6 Timing calculation of UC channel

The master shall calculate the time S-0-1017 NRT transmission time (t6 and t7) for the method 1 or method 2 under consideration of the parameters t1 and tScyc.

The duration of the UC channel should be set as great as possible.

Calculation for method 1 (m1):

- The time t6 (beginning of UC channel) shall be calculated as follows: t6.m1 = t1 + (t1 jitter) + AT block (t1 jitter = t1_transmit_jitter + IFG jitter)
- The time t7 (end of UC channel) shall be calculated as follows: t7.m1 = tScyc – (SYNC jitter) - tTH
- The master shall set the time t6 as small as possible --> t6 ≥ t6.m1
- The master shall set the time t7 as great as possible --> t7 ≤ t7.m1

Calculation for method 2 (m2)

- The time t6 (beginning of UC channel) shall be calculated as follows: t6.m2 = MDT block - tTH (+ Jitter)
- The time t7 (end of UC channel) shall be calculated as follows: t7.m2 = t1 – (t1 jitter)
- The master shall set the time t6 as small as possible --> t6 ≥ t6.m2
- The master shall set the time t7 as great as possible --> t7 ≤ t7.m2

Limitations of UC channel in CP3 and CP4

- The minimum duration of the UC channel = (t7 - t6) ≥ 5,8 μs + tIFG (0,96 μs)

Figure 53 shows the calculation of t6 and t7 for method 1 and 2 which are used in CP3 and CP4.

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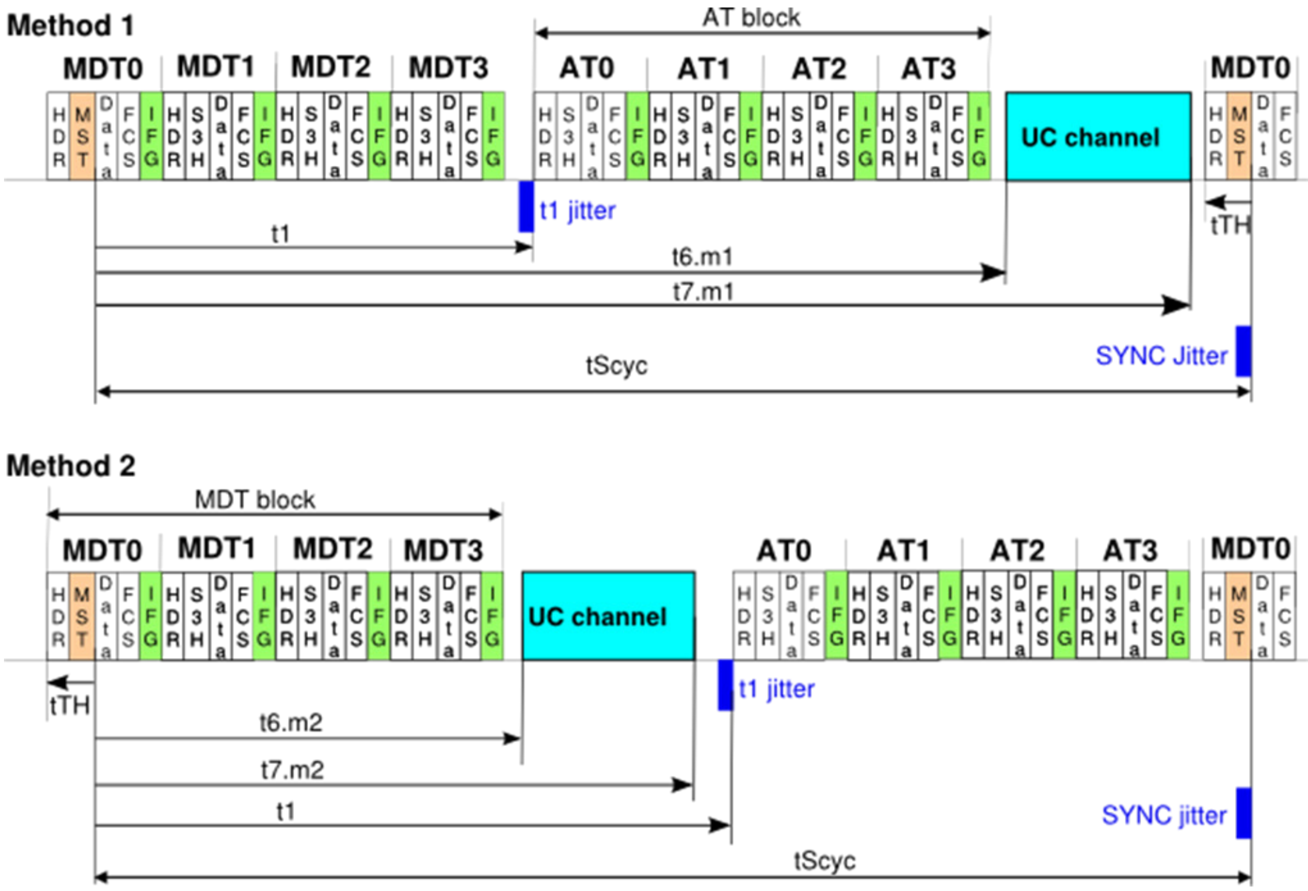

Figure 53 – Determination of UC channel

7.1.7 Telegram timing in CP0

The communication cycle time shall be preset by the master with 1 ms ≤ tScyc-cp0 ≤ 65 ms. The telegram timing of CP0 is shown in Figure 54. No transmission time is specified for AT0, but it shall be transferred after MDT0 and before the UC channel is activated (time t6cp0 is reached).

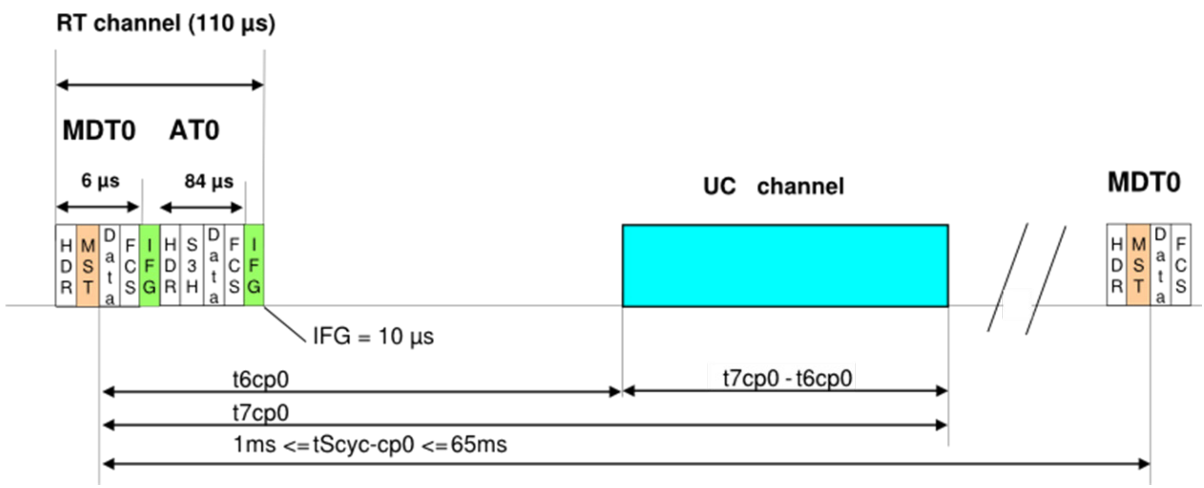

Figure 54 – Timing diagram of CP0

The default values of the timing in CP0 are defined in Table 91.

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7.1.8 Telegram timing in CP1 and CP2

Four telegram set-ups are possible in CP1 and CP2. Two set-ups have a minimum communication cycle time of 1 ms and can address up to 255 slaves (case 1 and case 3); the others have a minimum communication cycle time of 2 ms and can address up to 511 slaves (case 2 and case 4). An inter frame gap of 10 μs are used for all telegram set-ups.

- Case 1 (up to 255 slaves): The communication cycle time shall be preset by the master with 1 ms ≤ tScyc-cp1/2 ≤ 65 ms. The telegram sequence during CP1 and CP2 are shown in Figure 55. No transmission times are defined for MDT1, AT0 and AT1; but they shall all be transferred in that order before the time t6cp1/2 is elapsed (beginning of UC channel in CP1&2). The master shall send the next MDT0 after the time t7cp1/2. The Master may announce the transmission of the timing parameters of CP1/2 in the communication version. If the slave supports this functionality, then it shall acknowledge it by setting bit 15 = 1 of the topology index in AT0 of CP0. If the master didn't transmit the timing parameters of CP1/2 in the MDT0 of CP0 or the slave didn't evaluate or cannot accept these parameters, then it shall not acknowledge it by setting bit 15 = 0 of the topology index in AT0 of CP0. Therefore, the default values of CP1/2 shall be activated in the master and the slaves (see Table 91).

Table 91 – Default values of CP1/2 (case 1)

Parameter	Default value
t6cp1/2	650 μs
t7cp1/2	950 μs

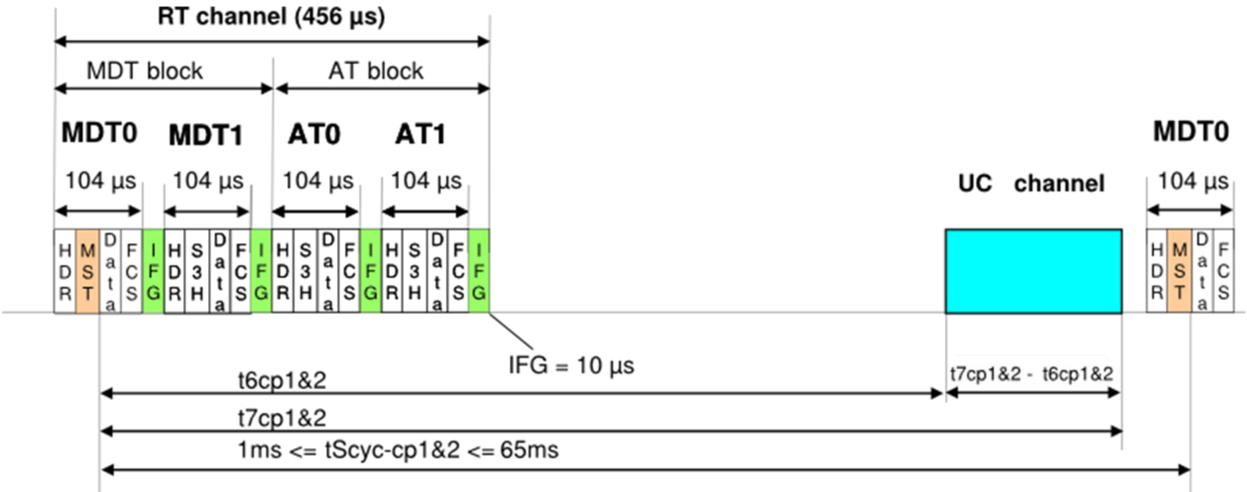

Figure 55 – Timing diagram of CP1 and CP2 with 2 MDT, 2AT and UC channel

- Case 2 (up to 511 slaves): The communication cycle time shall be preset by the master with 2 ms ≤ tScyc-cp1/2 ≤ 65 ms. The telegram sequence during CP1 and CP2 are shown in Figure 56. No transmission times are defined for MDT1, MDT2, MDT3, AT0, AT1, AT2 and AT3; but they shall all be transferred in that order before the time t6cp1/2 is elapsed (beginning of UC channel). The master shall send the next MDT0 after the time t7cp1/2. The Master may announce the transmission of the timing parameters of CP1/2 in the communication version. If the slave supports this functionality, then it shall acknowledge it by setting bit 15 = 1 of the topology index in AT0 of CP0. If the master didn't transmit the timing parameters of CP1/2 in the MDT0 of CP0 or the slave didn't evaluate or cannot accept these parameters, then it shall not acknowledge it by setting bit 15 = 0 of the topology index in AT0 of CP0. Therefore, the default values of CP1/2 shall be activated in the master and the slaves (see Table 92).

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Table 92 – Default values of CP1/2 (case 2)

Parameter	Default value
t6cp1/2	1050 µs
t7cp1/2	1950 µs

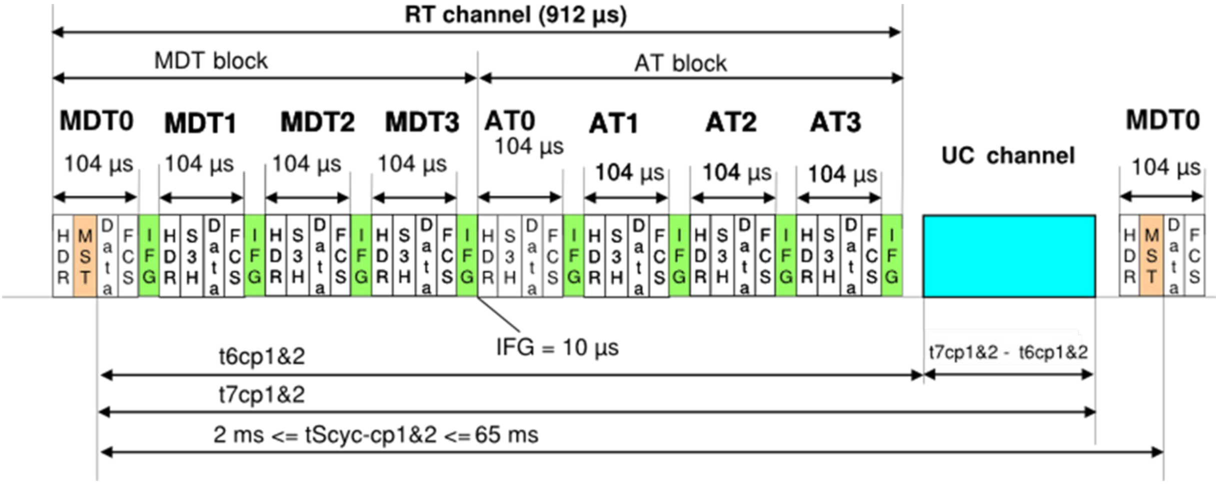

Figure 56 – Timing diagram of CP1 and CP2 with 4 MDT, 4 AT and UC channel

- Case 3 (up to 255 slaves): The communication cycle time shall be preset by the master with 1 ms ≤ tScyc-cp1/2 ≤ 65 ms. The telegram sequence during CP1 and CP2 are shown in Figure 57. The transmission time of AT0 (t1cp1/2) is defined. No transmission times are defined for MDT1 and AT1. MDT1 shall be transferred in that order before the time t6cp1/2 is elapsed (beginning of UC channel in CP1&2). AT1 shall be transferred in that order before the transmission of the next MDT0 is started. Therefore, the master shall send the next MDT0 after the end of the AT1. The Master may announce the transmission of the timing parameters of CP1/2 in the communication version. If the slave supports this functionality, then it shall acknowledge it by setting bit 15 = 1 of the topology index in AT0 of CP0. If the master didn't transmit the timing parameters of CP1/2 in the MDT0 of CP0 or the slave didn't evaluate or cannot accept these parameters, then it shall not acknowledge it by setting bit 15 = 0 of the topology index in AT0 of CP0. Therefore, the default values of CP1/2 shall be activated in the master and the slaves (see Table 91).

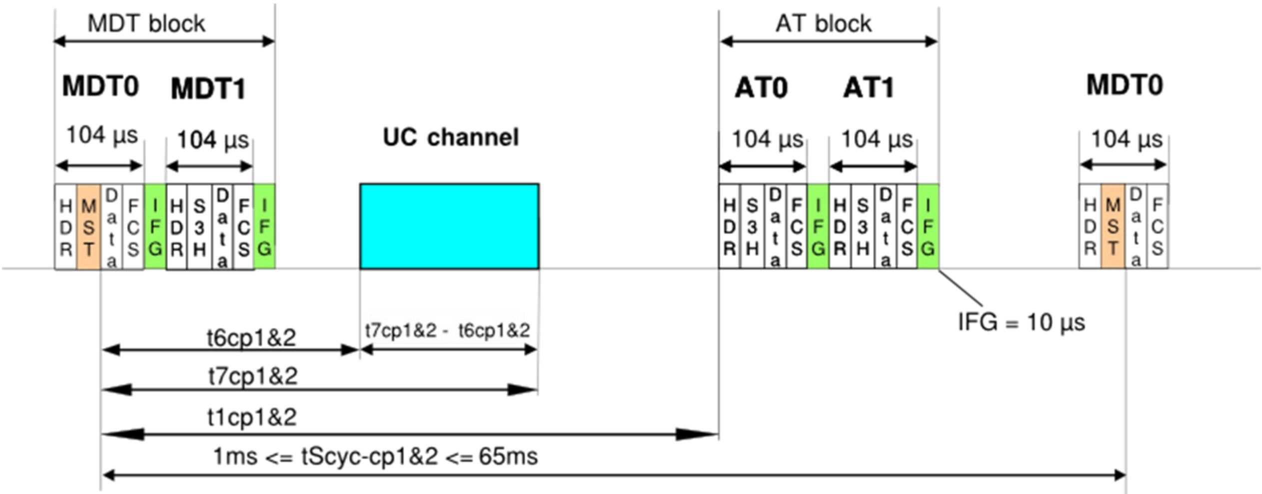

Figure 57 – Timing diagram of CP1 and CP2 with 2 MDT, UC channel and 2 AT

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- Case 4 (up to 511 slaves): The communication cycle time shall be preset by the master with 2 ms ≤ tScyc-cp1/2 ≤ 65 ms. The telegram sequence during CP1 and CP2 are shown in Figure 58. The transmission time of AT0 (t1cp1/2) is defined. No transmission times are defined for MDT1, MDT2, MDT3; but they shall all be transferred in that order before the time t6cp1/2 is elapsed (beginning of UC channel). No transmission times are defined for AT1, AT2, AT3; but they shall all be transferred in that order before the transmission of the next MDT0 is started. Therefore, the master shall send the next MDT0 after the end of the AT1. The Master shall announce the transmission of the timing parameters of CP1/2 in the communication version. If the slave supports this functionality, then it shall acknowledge it by setting bit 15 = 1 of the topology index in AT0 of CP0. If the master didn't transmit the timing parameters of CP1/2 in the MDT0 of CP0 or the slave didn't evaluate or cannot accept these parameters, then it shall not acknowledge it by setting bit 15 = 0 of the topology index in AT0 of CP0. Therefore, the default values of CP1/2 (case 2) shall be activated in the master and the slaves (see Table 92).

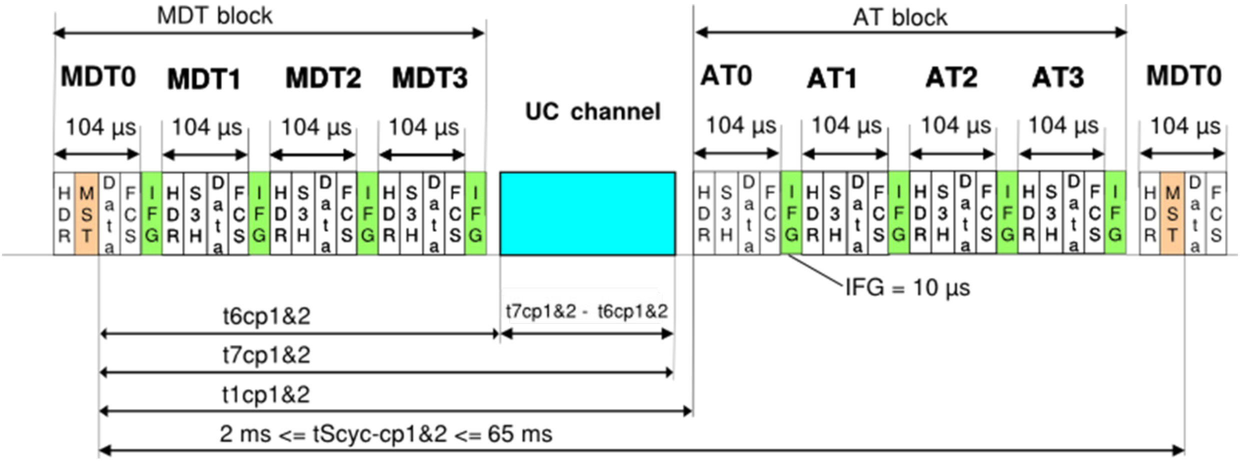

Figure 58 – Timing diagram of CP1 and CP2 with 4 MDT, UC channel and 4 AT

7.1.9 Telegram timing in CP3 and CP4

The sequence of transmitted Type 19 telegrams and UC telegrams shall be repeated every communication cycle. The time slots for the RT channel and the UC channel and the transmission time of the AT shall be transmitted during initialization and are therefore known by each slave. Figure 59 shows the two possible arrangements of the RT channel and the UC channel. The master shall always use one method out of these two, the choice of which depends on configuration.

NOTE Some control units calculate the new command values only after having received all feedback values. In method 1 there is more time available for the calculation of the command values. Method 2 is more appropriate for position control since the control unit can calculate the new command values while still receiving the feedback values.

A synchronous collision-free media access control shall be used in the RT channel. Telegrams shall be exchanged in fixed communication cycles. The master shall start the communication cycle strictly equidistant with the communication cycle time tScyc, by transmitting the MDT0. The next communication cycle shall start with the transmitting of the next MDT0. The communication cycle is defined from the end of the MST of communication cycle (n) to the end of the MST of the next communication cycle (n+1).

The MDTs (MDT0 to MDT3) shall be transmitted to all slaves. The MDT0 shall contain the synchronization information and the status of the communication in the MST field.

The ATs (AT0 to AT3) shall be transmitted by the master with the configured telegram length but the data field is filled with zeros. Each slave shall insert its real-time data into its allocated

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data field within the ATs. The sequence of the slave data fields within the ATs shall be independent of the physical order of the topology as well as the predefined sub-device address. The master shall be the final recipient of the ATs.

The data field length and content meaning of the MST and AT header shall remain constant and thus have the same length at each communication cycle.

Every Type 19 device may send its UC telegrams during the UC channel.

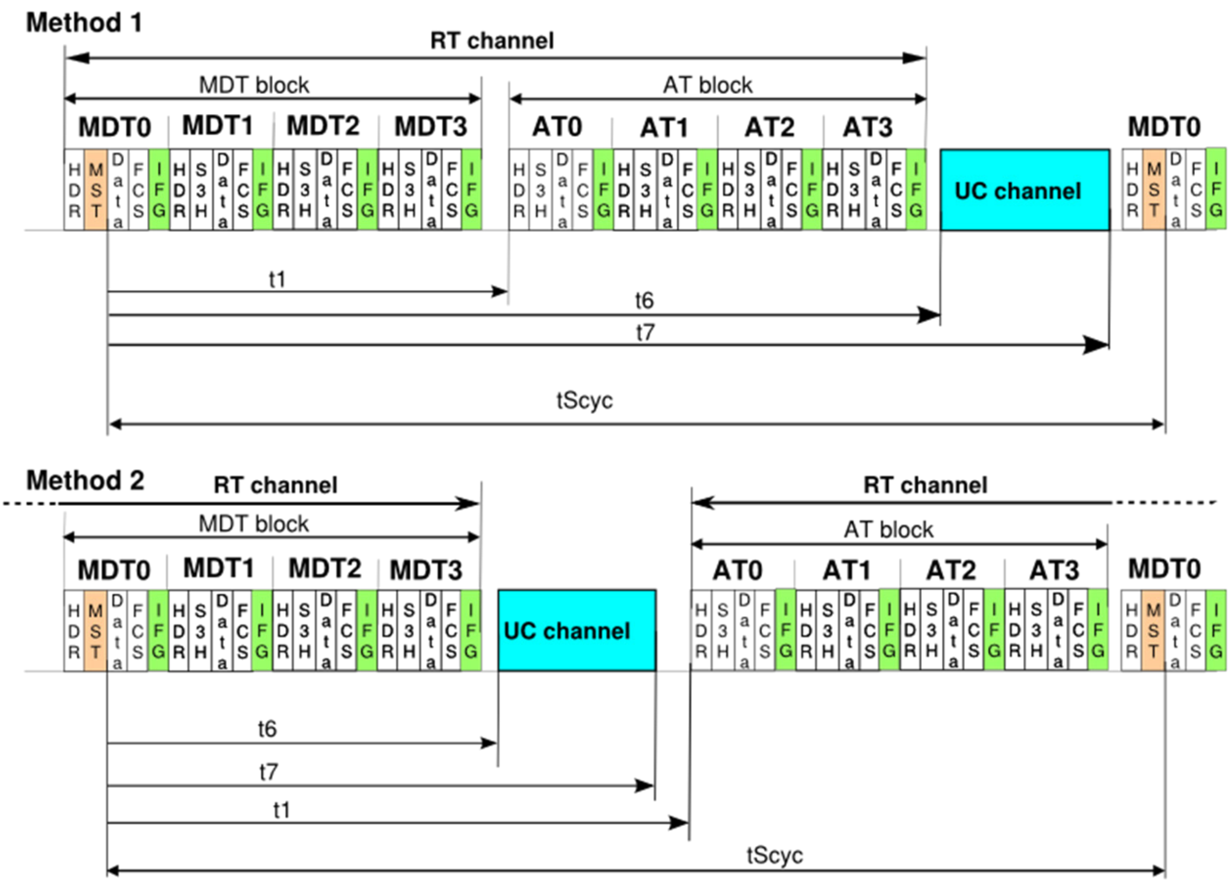

Figure 59 – Telegram sequence

7.1.10 NRT communication mechanisms

7.1.10.1 Introduction

Before the Type 19 real-time communication is initialized, communication with the slaves shall use standard IP mechanisms if it supports this function. As soon as initialization has started or is done, IP communication shall be possible only in the UC channel.

During the UC channel (time slot between t_6 and t_7) the participants shall send any kind of UC telegrams on one port depending on the destination MAC address. If the Type 19 network devices have not yet learned the right port, they shall send the UC telegrams on both ports.

The time t6 marks the beginning and t7 marks the end of the UC channel relative to the end of MST (Type 19 Header of MDT0 resp. the time TTref).

In CP0, CP1, CP2 the time slot between t6 and t7 is only available if the slave receives a valid MST. Otherwise the communication is not possible in this communication cycle.

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Each transmission of an UC telegram shall be canceled at time t7.

UC telegrams may be forwarded either immediately or later depending on communication load.

Type 19 telegrams shall be dropped when the time TTref (end of Type 19 header) is received between t6 and t7.

Loopback with forward shall never be active when the UC channel is active, even if a Type 19 device detects a communication interruption and becomes the last one in a line configuration.

In CP0, CP1 and CP2 the timing of the UC channel is defined with default values. In CP3 and CP4 the UC channel can be positioned before or after the ATs. These two positions are shown in Figure 60.

The method to calculate a valid time slot defined by t6 and t7 (S-0-1017), as well as the meaning of t1, tTH, etc. is described in 7.1.2. The UC channel may be deactivated by setting the time t6 to 0. In this case the collision buffer shall be deactivated in the master and the slaves also. This shall prevent that UC telegrams are stored in the collision buffer.

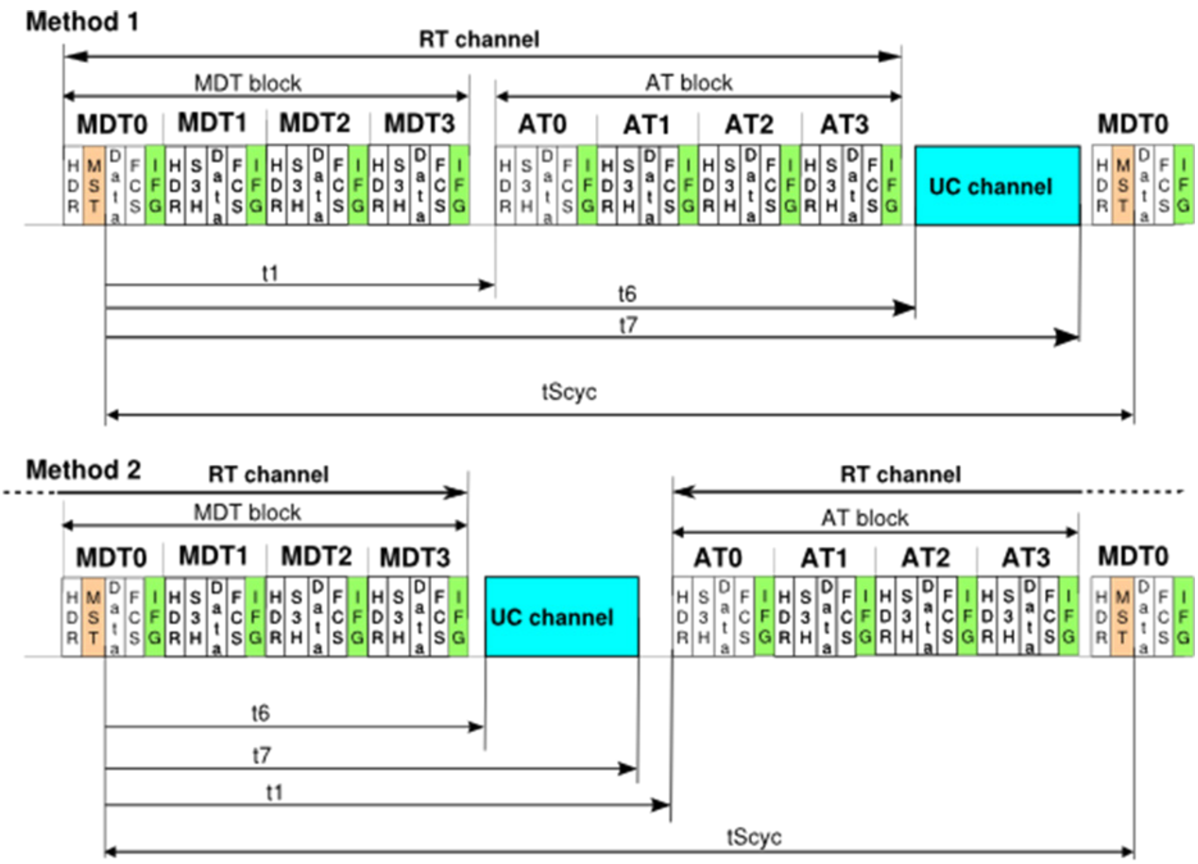

Figure 60 – The two defined positions of the UC channel.

- Sending UC telegrams:
  - First transmit: The first UC telegram shall be sent during the UC channel at the earliest 80 ns after the time T6 (beginning of UC channel). --> First transmit = T6 + 80ns (see Figure 61)
  - Last transmit: The last UC telegram shall be sent during the UC channel at the latest before the time T7 (end of UC channel) by considering the following conditions. -->

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Last transmit = T7 - period of IP telegram - switching from UC to RT channel (tHW) - IFG (see Figure 61)

- The period of the UC telegram (with preamble, DA, SA, type/length, payload and FCS),
- the time needed within the Type 19 device for switching from UC channel to RT channel (tHW) and
- the IFG with 12 octets (tIFG = 960 ns).

– After T7 (end of UC channel) the Type 19 device shall be able to process RT frames (Type 19 telegrams) immediately.

- Receiving UC telegrams: The receiving of UC telegrams shall be possible between T6 and T7 in a Type 19 device.

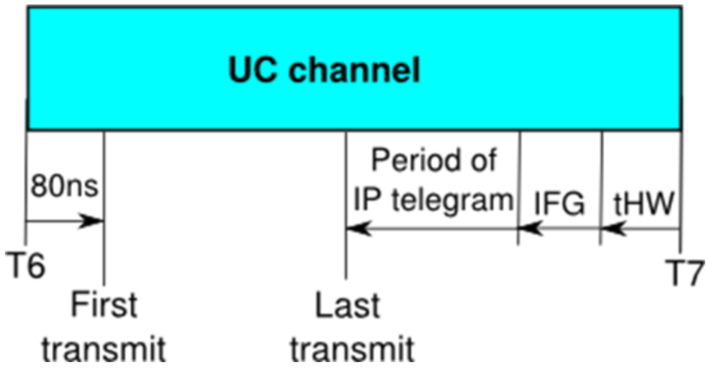

Figure 61 – First and last transmit during UC channel

7.1.10.2 Slaves within a line or a ring

If a slave receives a telegram while the UC channel is active and it is transmitting an Ethernet frame, the currently transmitted Ethernet frame shall not be interrupted and the incoming telegram shall be stored if possible.

Slaves shall always send their own Ethernet frames on one port (P1 or P2) depending on the destination mac address, provided that all following conditions are met before doing so:

- it is not already forwarding another telegram; otherwise the slave shall wait until this telegram has been fully forwarded;
- the remaining UC channel duration is long enough to fully transmit its own Ethernet frame;
- its memory has enough free capacity for storing at least one new incoming Ethernet frame with maximum length.

If the Slaves have not yet learned the right port, they shall send the frame on both ports.

7.1.10.3 Slave in the last position within a line

Although the last slave in a line has its loopback with forward active, it shall check for any incoming Ethernet frame on its inactive port. It shall forward Ethernet frames if its UC channel is active, provided that the remaining duration of this UC channel is long enough to fully transmit this Ethernet frame. It shall forward all incoming “non-Type 19” Ethernet frames as soon as the UC channel is active again, provided that the remaining duration of this new UC channel is long enough.

The last slave in a line topology shall use the MST at its active port also for its inactive port to support the timing of the UC channel.

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7.1.10.4 Forwarding of packets

Every Type 19 device that supports IP communication can send and receive packets on the primary and secondary port of its interface. Packets received on one port of a devices interface, which are not for the local device, need to be forwarded to and sent on the other port. This forwarding can either be done with the method store and forward or with the method cut through forwarding, explained in the next section.

Since the other port can already be busy, the interface has to buffer packets until the port is free. This buffer is called the Collision Buffer (CB).

The left side of Figure 62 shows a device with an activated collision buffer as well as the receive and send buffers of P and S port.

The right side shows a device with a deactivated collision buffer.

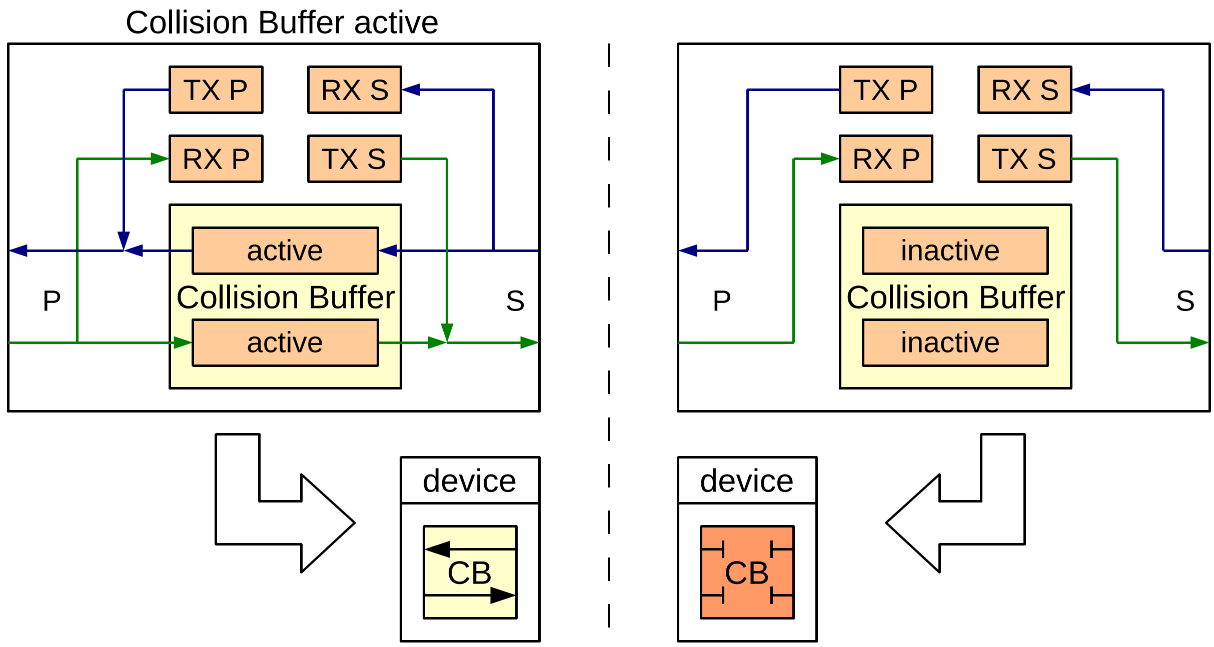

Figure 62 – Activated and deactivated collision buffer

7.1.10.4.1 Store and forward

Store and forward defines that each packet shall be received and buffered completely.

- The frame check sequence (FCS) of packets is checked.
- If the FCS is invalid, the packet will be discarded.
- Otherwise the packet will be forwarded to the next station towards its destination.

With this method of forwarding, the packet will be delayed at each station for a time about equal to its transmission time. Figure 63 shows the time response between an input port and an output port for a forwarded packet.

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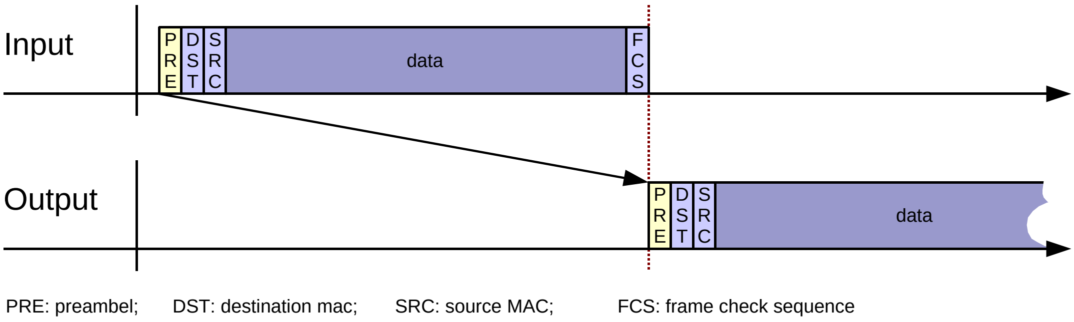

Figure 63 – Time response of store and forward method

7.1.10.4.2 Cut through forwarding

In opposite to store and forward, cut through forwarding does not wait until a packet is received completely. Cut through forwarding rather starts forwarding packets as soon as it knows the packet's destination.

- This means, that on the one hand each packet is delayed only for a time about equal to the transmission time of the preamble and destination mac address (approx. 1,2 µs at 100 Mbit/s).
- On the other hand packets with an invalid FCS will not be discarded.

Figure 64 shows the time response between an input port and an output port for a packet forwarded with cut through forwarding.

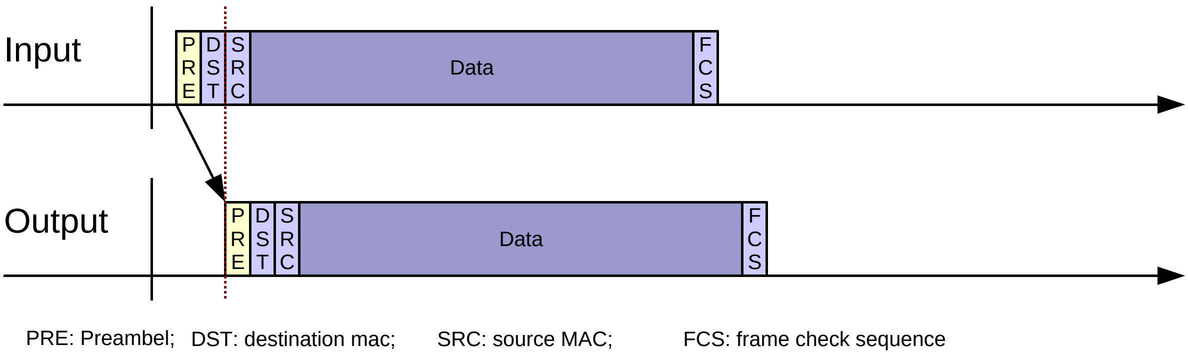

Figure 64 – Cut through forwarding

7.1.10.5 Timing at the end of the UC channel

All IP packet transmissions shall be finished at the end of the UC channel (t7). Therefore the start of each packet transmission needs to be early enough. This means that the start of transmission tTS shall be at least the packet's transmission period tTP before t7 but not before t6.

Expressed as a formula this means: t6 < tTS < (t7 - tTP)

7.1.10.5.1 Last transmission of CP0,CP1 and CP2

With the default value (576) of MTU in CP0 to CP2 the last start of transmission shall be at least ≥ 50 µs before end of UC channel.

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7.1.10.5.2 Transmission period of an Ethernet frame

Figure 65 shows a complete ethernet packet followed by the formula to calculate the transmission period of an Ethernet frame.

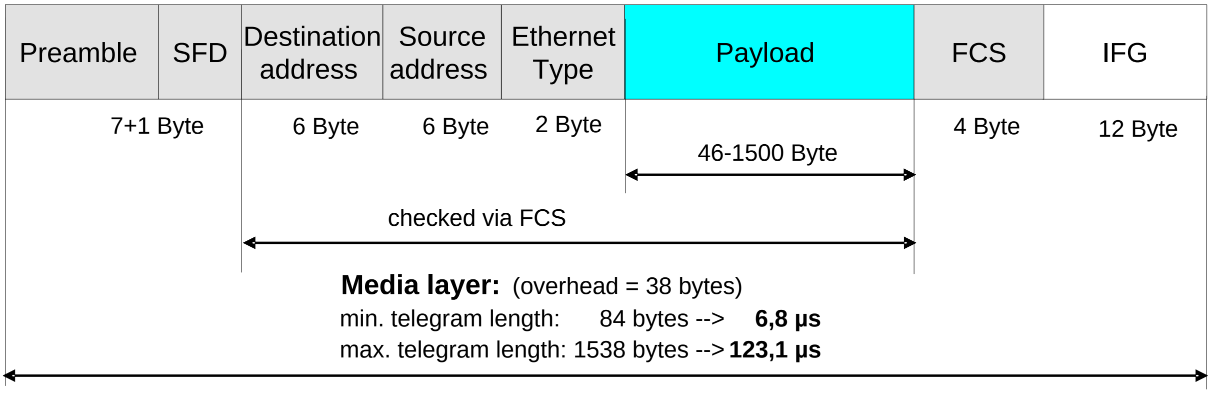

Figure 65 – Ethernet frame with payload

According to Figure 65 the period of an Ethernet frame shall be calculated like shown in the following formula.

- Preamble: = 8 octets
- Destination address: = 6 octets
- Source address: = 6 octets
- Ethernet type: = 2 octets
- FCS: (frame check sequence) = 4 octets
- IFG: (inter frame gap) ≥ 12 octets (depending on number of nodes in the topology, see S-0-1036 Inter Frame Gap)
- Payload: this is a variable that shall contain the amount of octets for the desired payload for which tTP shall be calculated

Calculation of transmission period:

- Length [octets] = 26 octets + Payload + IFG
- Transmission period (tTP) [µs] = length [octets] * 8 [bit] * 0,01 [µs]
- Transmission period min = 6,8 µs (with 12 octets IFG)
- Transmission period max = 123,1 µs (with 12 octets IFG)

7.1.10.5.3 Maximum payload based upon the UC channel length

The duration of the UC channel (tNRT = t7 - t6) can be set to arbitrary values down to 7µs. An Ethernet frame can only be transmitted during the UC channel if it fits into it.

This means, that the UC channel must be longer than the transmission period: tNRT > tTP. The amount of octets that fit into a given duration of time is calculated with this formula:

amount of octets = period of UC channel [µs] * 12,5 [octets/µs] - 38 octets

Example:

If the UC channel has a duration of 250 µs, the maximum possible payload would be: 250 [µs] * 12,5 [octets/µs] - 38 = 3087 octets

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NOTE Ethernet specifies that the maximum payload of one packet on Ethernet is 1500 octets.

7.1.10.6 MTU and issues with packets sizes

7.1.10.6.1 General

Ethernet allows a payload of up to 1500 octets per packet. The UC channel of a Type 19 network can be configured to be shorter than ΔtTP(1500octets). This means, that the maximum payload of packets in the UC channel needs to be limited. This limit is usually called the maximum transmission unit (MTU) which describes the maximum payload, in octets, for a single packet, that may be transmitted over a network without fragmentation. The upper limit of the MTU can be calculated using the formula of the previous section:

$$MTU_{UL}(\Delta_{NRT}) = \min\{1500; a(\Delta(_{NRT})\}$$

Ethernet specifies that the minimum value of the maximum transmission unit (MTU) is 46 octets. If the calculated upper limit of the MTU, MTU_{UL} is lower than 46 octets, the UC channel shall be deactivated.

The MTU affects two places within a Type 19 device:

- network device interface of the devices network stack
- the Type 19 communication hardware

7.1.10.6.2 MTU and network stack interfaces

Every network interface of a network stack usually has a MTU attribute. This is necessary, so that higher layer protocols like IPv4 can find out what maximum packet size they may deliver to the interface. Therefore the network stack interface's MTU shall be set and updated according to S-0-1027.0.1.

7.1.10.6.3 MTU and Type 19 networks

A special MTU can be requested by a communication master using a slaves S-0-1027.0.1 Requested MTU. In this IDN, the master can set the requested MTUreq. The current MTUcur is dependent on S-0-1017 NRT transmission time and calculated by the slave at phase change and on write access to S-0-1027.0.1 Requested MTU. A master can read a slaves current MTUcur out of S-0-1027.0.2 Effective MTU.

7.1.10.6.4 Additional notes

- For one Type 19 line or ring, every device should be configured to the same MTU. If not, it is likely that packets will be lost. There will although, be no issues while the line or ring is in NRT state.
- Path MTU discovery (PMTUD) as specified in RFC1191 shall be supported by all devices, especially devices that route packets between different networks.
- The default value for the requested MTU is 576 octets.

7.1.10.7 Topology issues

Every Type 19 device needs to care about these issues regarding the topology of a Type 19 network:

- Collision buffers: Every Type 19 device has a collision buffer that forwards packets from one port to the other port. In order to avoid broadcasts running around forever in Type 19 ring topologies, exactly one of the collision buffers needs to be deactivated.
- Port/MAC table: Every device (masters, slaves and other components like IP plugs) that injects IP packets into a Type 19 ring sends each IP packet on both the primary and secondary port. This means that each packet is duplicated when it is injected into a Type

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19 ring. To prevent this packet duplication, every device needs to know, on which port every single packet needs to be sent.

7.1.10.8 Port/MAC table of devices

7.1.10.8.1 General

Section 4.5.2.9 of the Type 19 communication specification defines, that packets shall only be sent on one port during the UC channel. Therefore each Type 19 device needs a table, in which it stores known port/MAC relations. The structure of this table as well as its handling is described in the following sections.

7.1.10.8.2 Structure

Every Type 19 device shall maintain a table (see Table 93) in which it keeps track of which device it reaches on which port. This table is called the port/MAC table and consists of at least two columns, one for a port entry, the other for a MAC entry.

Table 93 – Structure of port/MAC table

Port	MAC
...	...
...	...

7.1.10.8.3 Insertion of rows

Every time a device receives a IP packet from another device, it shall update its Port/MAC table accordingly. E.g. if a device with an empty port/MAC table receives a packet with source address 0d:ea:d0:0b:ee:f0 on port P2, the updated table shall look as shown in Table 94.

Table 94 – Insertion of entry

Port	MAC
P2	0d:ea:d0:0b:ee:f0
...	...

If the same device receives another Ethernet frame with the same source address 0d:ea:d0:0b:ee:f0 but this time on port P1, it shall update its port/MAC table as shown in Table 95.

Table 95 – Update of entries

Port	MAC
P1	0d:ea:d0:0b:ee:f0
...	...

7.1.10.8.4 Deletion of rows

There are some cases, in which entries of the port/MAC table need to be deleted:

- Every device shall clear its port/MAC table completely when switching from NRT state to CP0.
- Every master device shall clear its port/MAC table completely when a change of the physical topology has been detected. Every master device shall therefore adjust the bit 11 in the device control of all slaves accordingly.

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- Every slave device shall clear its port/MAC table completely when bit 11 in its device control has been toggled.
- If the port/MAC table has no more spare rows, obsolete rows shall be removed. The algorithm that decides which rows are obsolete is relinquished to the programmers creativity.

7.1.10.9 Collision Buffer

7.1.10.9.1 General

In order to avoid having a ring, where Ethernet broadcast packets run around in circles, exactly one collision buffer has to be inactive when a physical ring topology is set up. Since the master of a Type 19 ring shall always be aware of the topology, the master shall set its collision buffer according to the current topology. There are two exceptions in which a master will detect a wrong topology. In this exceptions one slave shall deactivate its collision buffer.

7.1.10.9.2 Slave collision buffer

At power on and during the boot sequence, every slave shall switch off its collision buffer. As soon as the slave has finished its boot sequence, the collision buffer shall be set according to Table 96:

Table 96 – Slave collision buffer

Collision Buffer Slave	Condition
Inactive	(NRT state or HP0) and (receiving P- and S-telegrams) and (CP > 0)
active	all other cases

That is the slaves collision buffer shall only be inactive if all of these three conditions are true:

- the slave is in NRT state or HP0
- the slave receives Type 19 P- and S-telegrams
- the communication phase of the received Type 19 telegrams is greater than 0.

This is necessary for a master to differentiate between a recovered broken ring and a broken ring with Type 19 slaves in between. If the slaves would not deactivate their collision buffer, a master would assume that the actual topology is a unhealed ring. The Figure 66 and Figure 67 below visualize these two issues.

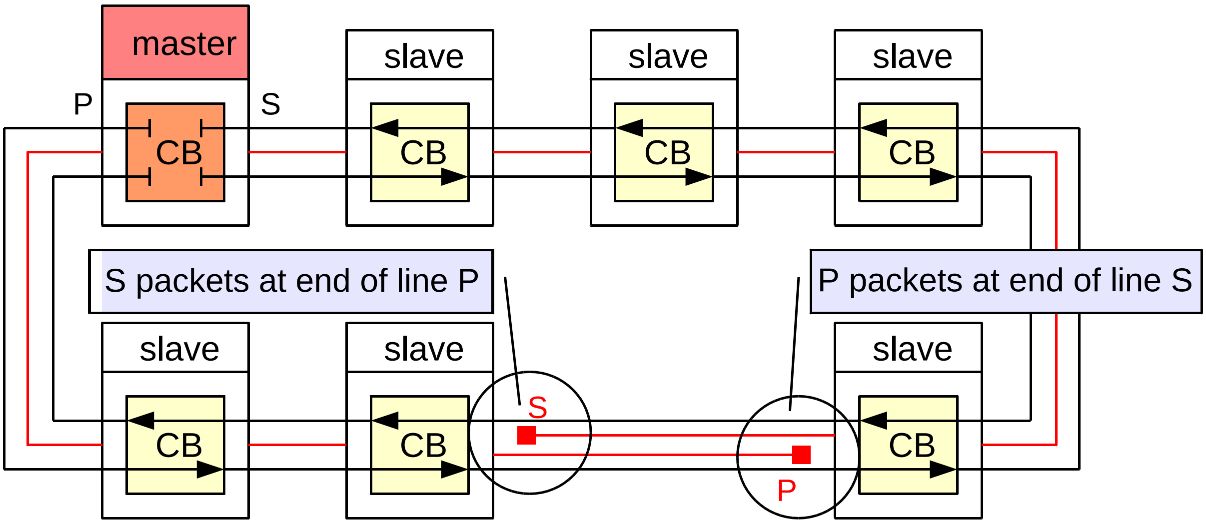

Figure 66 – Unhealed broken ring

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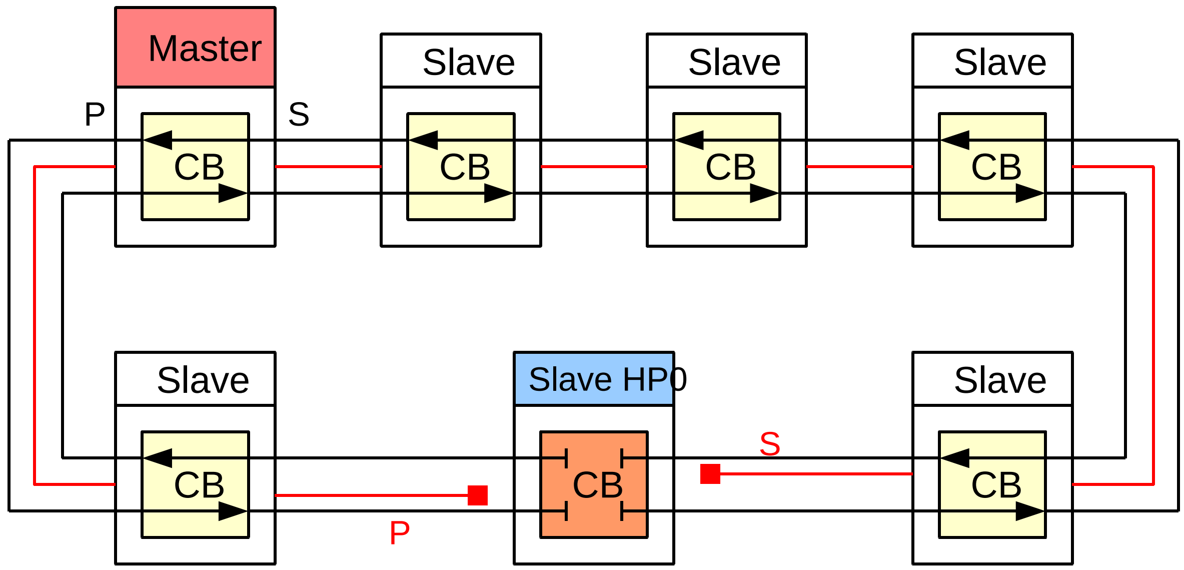

Figure 67 – Broken ring with Type 19 slave in between

7.1.10.9.3 Master collision buffer

The state of the master collision buffer is dependent of the communication phase. The following sections describe how the master collision buffer shall be set for the different phases.

7.1.10.9.4 NRT state

Every master shall keep the last known state of its collision buffer. If there is no known state, for example after power on, it is recommended, that every master switches to CP0 to determine the physical topology until the AT becomes stable for 100 cycles.

7.1.10.9.5 Communication Phase 0

Every master shall detect the physical topology by looking at the received packets on its ports (see Table 97).

- A physical ring is present, if the master receives S-packets on its P-port and P-packets on its S-Port. In this case the master shall deactivate its collision buffer.
- In all other cases, its collision buffer shall be activated.

Table 97 – Physical topology Master (CP0)

Comment	Packets received by Master on P-channel	Packets received by Master on S-channel	Collision Buffer Master
ring topology	S	P	inactive
no ring topology	*	*	active

7.1.10.9.6 Communication Phases 1 - 4

In the following cases the master collision buffer shall be deactivated. In all other cases it shall be activated. Note, that »UC Port of last Slave on P-channel« refers to the device status bits 10 and 11 of the last Type 19 slave on P-channel in line topology. »UC Port of last Slave on S-channel« refers to the device status bits 10 and 11 of the last Type 19 slave on S-channel in line topology (Table 98).

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Table 98 – Physical topology Master (CP 1-4)

Comment	Status of inactive port of last slave on P-channel	Packets received by Master on P-channel	Packets received by Master on S-channel	Status of inactive port of last slave on S-channel
broken ring between master S-Port and last slave of P-channel	S-Telegram on inactive port	P	P	no last slave on S-channel
ring topology	no last slave on P-channel	S	P	no last slave on S-channel
broken ring; HP1/2 on P-channel	P-Telegram on inactive port	P	S	P-Telegram on inactive port
physically closed but unhealed Type 19 ring	S-Telegram on inactive port	P	S	P-Telegram on inactive port
broken ring between master P-Port and last slave of S-channel	no last slave on P-channel	S	S	P-Telegram on inactive port
broken ring; HP1/2 on S-channel	S-Telegram on inactive port	P	S	S-Telegram on inactive port

7.1.11 Internet Protocol Services (IPS)

7.1.11.1 Introduction

The Type 19 Internet protocol services specify different services for NRT communication participants in a Type 19 network. They use the following protocols:

- UDP
- TCP
- TFTP

NOTE Internet protocol services assume a well configured IP network.

The services are categorized according their functionality as follows:

- S/IP Connection Services: Connection services, which are required for TCP based S/IP data exchange
- Explore & IP Configuration Services: Services for:
  – Detection of devices in Type 19 networks
  – IP configuration of devices to enable point to point communication
- Identification Services: Services for the identification of S/IP devices
- Parameter Access: Read and write access to Type 19 parameters (IDNs)
- Device Management Services:
  – Restart devices
  – TFTP Firmware Management
- Other Services:
  – Identification of supported services
  – Supervision of services based on a watchdog mechanism

By the help of these services, the following use cases become realizable:

- Identification and configuration of IP devices within Type 19 networks

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- Desk test of a device
- Maintenance or diagnosis of devices within an industrial plant

7.1.11.2 General definitions

7.1.11.2.1 Data types

Table 99 shows the data types that are used within the S/IP PDUs.

Table 99 – Definition of data types

Type	Definition	Comment
Bool	1 octet	Coding: 0(false), !=0 (true)
byte, uint8	1 octet unsigned integer	
int8	1 octet signed integer	
int16	2 octet signed integers	Coded in little endian
int32	4 octet signed integers	Coded in little endian
uint16	2 octet unsigned integers	Coded in little endian
uint32	4 octet unsigned integers	Coded in little endian
string	utf-8 coded	Fix-Len: • There are fixed number of reserved bytes. • The unused bytes shall be zero. • There is no terminating 0, if the coding completely fills up the reserved number of bytes! Variable-Len: • A leading explicit length contains the number of bytes. • There is no terminating 0.

The Type 19 specific IDN data (min, max, operation data) is exchanged as byte arrays.

7.1.11.2.2 Alignment

There are no spare octets due to an alignment.

7.1.11.2.3 Services

The IPS are different services, which can be accessed using different transport protocols. Due to specific limitations of the used protocols, not every transport protocol can be used for each service.

7.1.11.2.4 Node Identifier

Since the nodes in a Type 19 network may have more than one network interface, a node may be detected multiple times. In order to identify a node in network uniquely, another identifier, the so called node identifier, is introduced. The node identifier consists of six bytes. For slave devices the value of the node identifier shall be equal to the value of S-0-1019 MAC Address.

For nodes that support the IPS but do not have any Type 19 slave interface, the MAC address of the first Ethernet adapter shall be used as node identifier. Nodes without Ethernet interface cannot offer the IPS.

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7.1.11.3 Transport Protocols

7.1.11.3.1 Introduction

Internet protocol services (IPS) use TCP, UDP and TFTP as transport protocols. Depending on the characteristics of a particular service, one or more of these transport protocols can be used for the transmission.

All these protocols run on top of the Internet Protocol (IP). The IPS do not support any fragmentation on the IP layer.

Table 100 gives an overview of the differences between TCP, UDP and TFTP based IPS transmission.

Table 100 – Overview on IP-based protocols

Restriction/ Addition	TCP	UDP	TFTP
Data exchange	Based on TCP sockets	Based on UDP datagrams	Based on UDP datagram
Limitation of data size	No limitation	Depends on MTU size	TFTP does not support the transfer of files which are larger than 32MB, required minimum MTU size is 576 Byte
Reliable transmission	yes	no	yes
Flow control	yes	no	yes
Multicast communication	no	yes	no
Requires additional S/IP connections	yes	no	no

7.1.11.3.2 UDP based S/IP Protocol Handling

7.1.11.3.2.1 General

UDP based S/IP requests are generally transmitted to UDP server port 35021 (0x88cd). The client shall use a socket bound to any port except 35021.

Depending on the used service S/IP uses broadcast or unicast UDP telegrams. In general unicasts are used to address single S/IP nodes and broadcasts are used to address multiple nodes.

7.1.11.3.2.2 Limitations of PDU size

The maximum size of UDP based S/IP transmission is restricted to the configured MTU size.

The following restrictions to the response packet can be derived by considering a regular UDP packet. Every S/IP telegram contains a fixed part which is 50 octets in size, i.e.

- 14 octets Ethernet II Header
- 20 octets IP header without optional fields
- 8 octets UDP header
- 8 octets S/IP header (Transaction ID, Message Type)

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Hence minimum size of response PDU is 50 octets. If the total size of a S/IP response exceeds the configured MTU size, the server must respond by sending an exception (see 7.1.11.4.3).

NOTE In order to be able to use TFTP over UDP the MTU size has to be at least 576 octets, see also RFC-879.

7.1.11.3.2.3 Reliability of Transmission

In general UDP does not guarantee the exchange of messages. Request or response messages may be lost during the communication.

In order to overcome this problem, the client shall implement a timeout for each request. After the timeout, the client may send the same request again with the same transaction ID or new transaction ID.

The server will process each incoming request and send the response back to the client. The server shall not implement a functionality to ensure that duplicated requests will be executed only once.

7.1.11.3.2.4 Unicast Services

S/IP services using UDP unicasts can be used if server and client are in the same or in different subnets. The response of the server response is a UDP unicast too.

7.1.11.3.2.5 Broadcast Services

S/IP uses UDP broadcasts to

- reach many devices with one request
- enable communication to non-well configured devices. For example: a device may be connected to the same physical network, but has an unknown or invalid IP configuration. The IP address may be of an invalid or different subnet.

UDP broadcast telegrams can be responded by the server with UDP unicast or UDP broadcast messages. If the IP subnet of the client is different from the IP subnet of the server, the server shall send the response as a broadcast message. Otherwise the response shall be sent as a unicast message to avoid CPU load on other devices.

7.1.11.3.3 TCP based S/IP Protocol Handling

7.1.11.3.3.1 General

S/IP requests are generally transmitted to TCP server port 35021 (0x88cd). The client can use any port assigned by its TCP stack.

If TCP based S/IP is used, an S/IP connection has to be established before further S/IP services can be requested.

7.1.11.3.3.2 S/IP Connections

The S/IP connection provides the following features:

- The S/IP connection is established by the client.
- The S/IP connection is timeout controlled by the client and the server.
- The S/IP connection properties including timeouts, version information and supported message types are negotiated during connection start-up.
- The server may offer several connections. The client may connect to one server several times by using several TCP sockets.

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- While shutting down the connection, all the resources used internally should be released in the client and the server.

The S/IP connection has to be established after the initiation of the TCP socket connection.

The services required for the connection initiation are described in S/IP Connection Services.

If the server is not able to serve a TCP based S/IP connection the server shall send an exception to the client (see 7.1.11.4.3).

S/IP Connections are controlled by the following two timeouts.

- Lease timeout: The lease timeout specifies the amount of time after which the server shutdowns an idle connection to the client. This timeout exists to save resources on the server in case of losing the link to the client without a proper shutdown of the TCP connection. The client should use the S/IP Ping Service to prevent the lease timeout. Every new request from client shall restart the lease timeout at the server.
- Busy timeout: The busy timeout specifies the amount of time within which the server should send a response to the client's request. If the server is processing the request and is not able to send the response within the busy timeout, it shall send busy responses to the client with the cycle of the busy timeout. If the client receives neither the busy response nor the response to pending request within the busy timeout, it shall shutdown the connection to the server.

Every response from server shall restart the busy timeout at the client. Figure 68 shows an example for busy response messages.

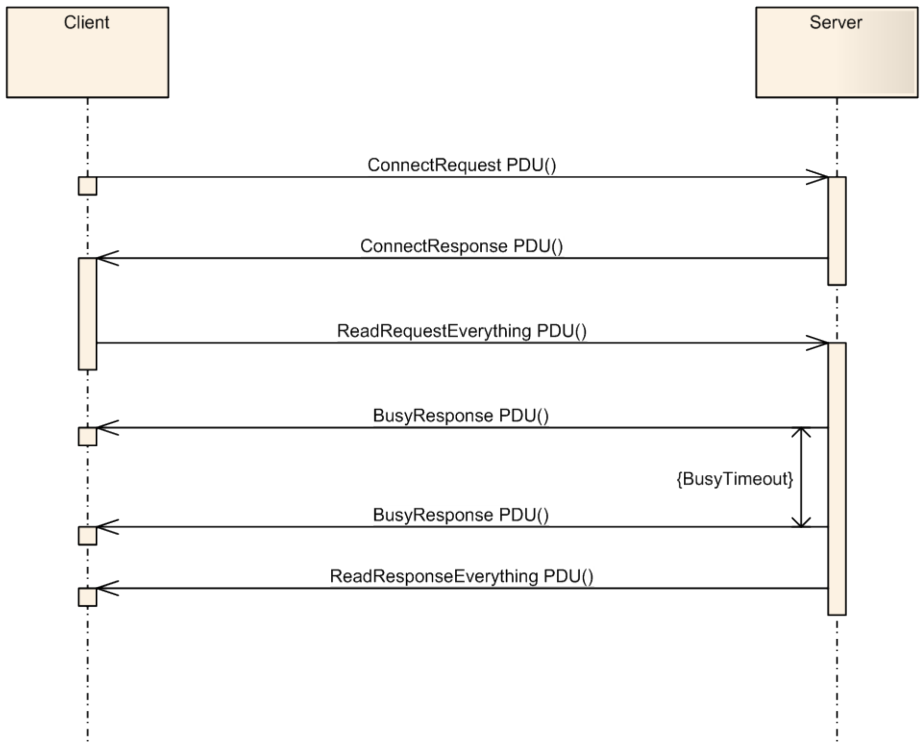

Figure 68 – S/IP busy response

The busy response restarts the busy timeout of an open request. The busy response looks as follows:

struct BusyResponse // MessageType: 68

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{

}

Figure 69 shows a state machine of an S/IP connection from the client's point of view, including all states and transitions for busy- and lease-timeout, which needs to be implemented by S/IP client.

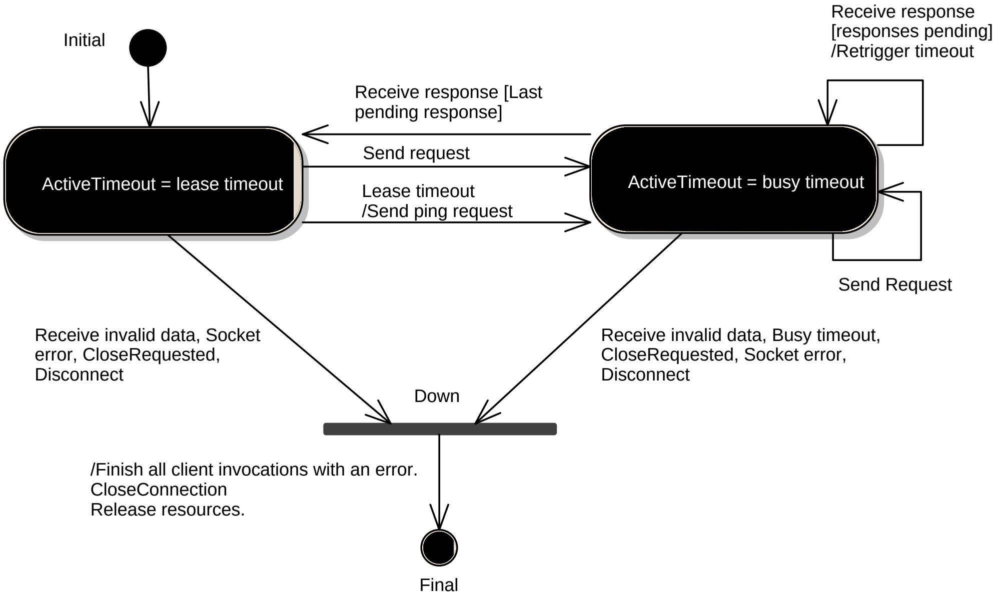

Figure 69 – Client connection

Figure 70 shows a state machine of an S/IP connection from the server's point of view, including all states and transitions for busy- and lease-timeout which needs to be implemented by S/IP server.

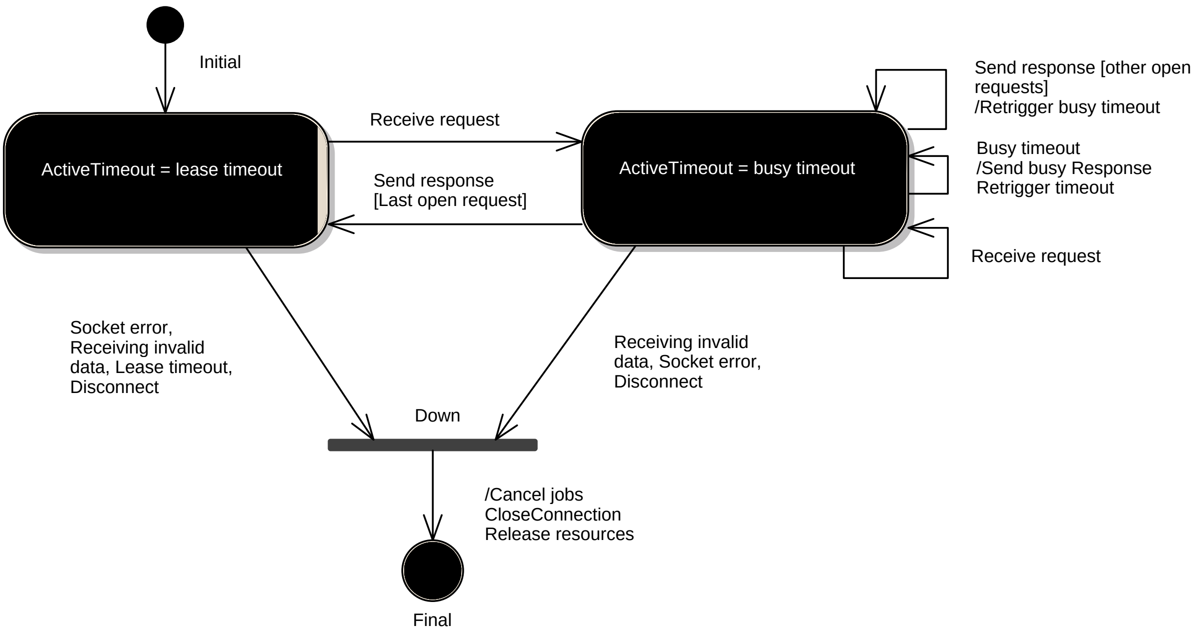

Figure 70 – Server connection

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7.1.11.3.4 TFTP

TFTP as specified in RFC 1350 shall be the standard protocol for file transfer.

The Type 19 device shall implement a TFTP server.

- The file name activates an associated action on the Type 19 device.
- The content shall be checked by the Type 19 device. If the Type 19 device is in an improper operation state, it shall return the corresponding TFTP error message. E.g. access violation including a meaningful error message.
- The string error-message of the TFTP protocol shall be used to transmit meaningful error messages in readable form.
- It shall be possible to upload firmware via TFTP.

It is allowed to trigger functions or commands in the device via TFTP using special file names. Functions, file names and file contents are vendor specific and not defined by Type 19.

NOTE TFTP does not support the transfer of files which are larger than 32 MB.

7.1.11.4 Communication

7.1.11.4.1 General

Each S/IP service is defined by a request and a response message. The client can send several requests before it receives any response from the server. Furthermore the server can process incoming requests in any order.

Figure 71 shows an example of three requests answered by the server in a different order.

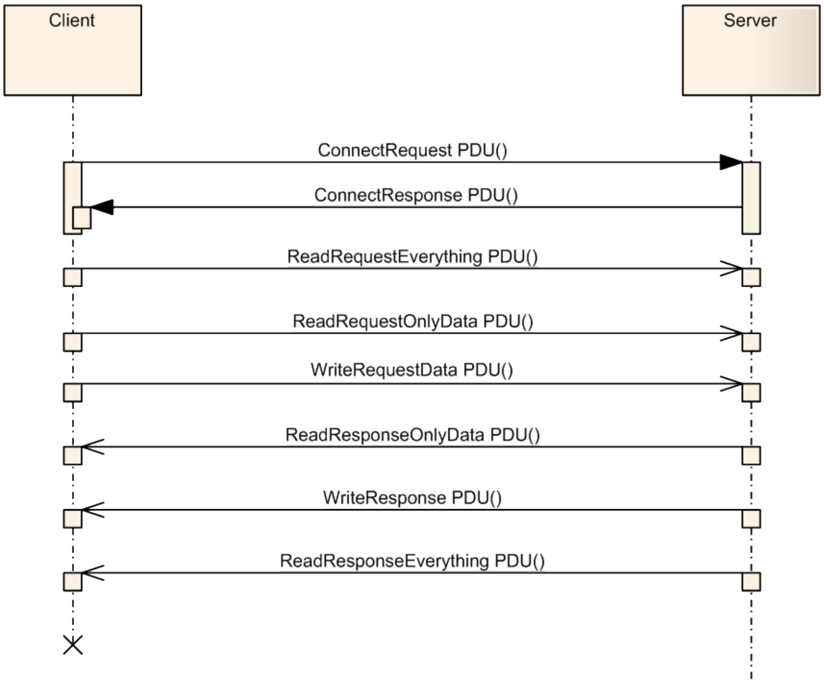

Figure 71 – S/IP asynchronous request

If the server receives a request with an unknown message type, the request shall be ignored and an exception shall be returned to the client. Broadcast messages with an unknown message type shall not be responded with an error exception (see 7.1.11.4.3).

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Every request and response is composed of a S/IP Header followed by a S/IP service data unit (SDU), shown in Figure 72.

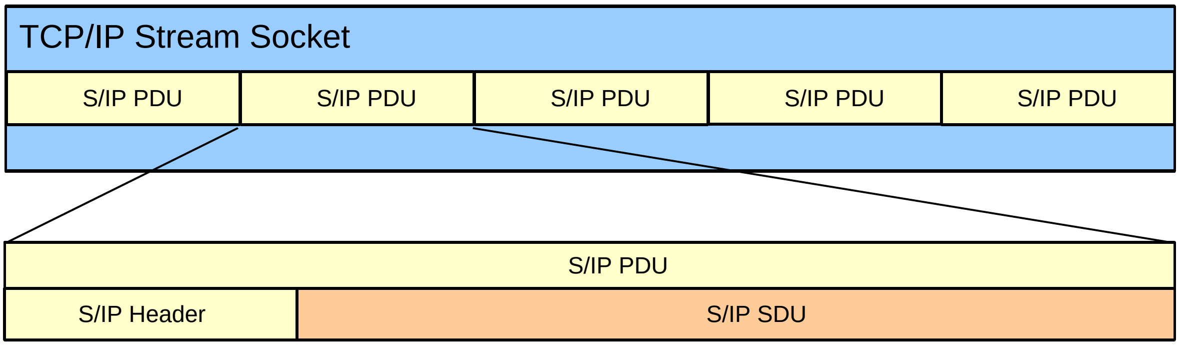

Figure 72 – S/IP PDU

7.1.11.4.2 S/IP Header

7.1.11.4.2.1 General

The S/IP header contains a transaction identifier and the message type of the PDU. The structure looks as follows:

```
struct header {

  uint32 TransactionID;

  uint32 MessageType;

}
```

7.1.11.4.2.2 Transaction ID

In order to distinguish different request-response pairs in the client, the S/IP header contains a transaction identifier. This transaction identifier is an identification number which is set by the requesting client for each request. The server uses the same transaction identifier (as of request) for the corresponding response. The client uses this transaction identifier of a response to assign the response to a corresponding pending request.

7.1.11.4.2.3 Message Types

The message type identifies the requested service of the Type 19 devices.

Table 101 shows the services that have been standardized by S/IP.

Table 101 – Message Types

S/IP Services	Message Type Request	Message Type Response	TCP	UDP
SupportedUDPServices	61	62	-	X
Connect	63	64	X	-
Ping	65	66	X	X
ReadEverything	69	70	X	X
ReadOnlyData	71	72	X	X

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S/IP Services	Message Type Request	Message Type Response	TCP	UDP
ReadDescription	73	74	X	X
WriteName	75	76	X	X
WriteAttribute	77	78	X	X
WriteUnit	79	80	X	X
WriteMinMax	81	82	X	X
WriteData	83	84	X	X
WriteDataBits	85	86	X	X
ReadDataStatus	87	88	X	X
Nameplate	89	90	X	X
NameplateBroadcast	99	-	-	X
Browse	91	100	-	X
Identify	93	94	-	X
SetIp	95	96	-	X
Watchdog	101	102	X	X
Interfaces	103	104	X	X
Slaves	105	106	X	X
BrowseOnSlaveInterfaces	107	108	X	X
ReadSegment	109	110	X	X
Exception	-	67	X	X
Busy	-	68	X	X
Reset	97	-	-	X
Reserved	92	-	-	-

Manufacturer-specific MessageTypes set the most significant bit of the MessageType to 1 (see Table 102). The following 15 bits contain the actual manufacturer-specific MessageType (0..32767). The least significant 16 bits contain the Vendor Code managed by SI (S-0-1300.x.03 Vendor Code).

Table 102 – User-specific Message Types

(User specific) Message Type	1uuuuuuuuuuuuuuuvvvvvvvvvvvvvvvv (binary)
u: User specific Message Type	(0..32767)
v: Type 19	VendorCode

7.1.11.4.3 Exception Handling

7.1.11.4.3.1 General

If a service is requested, which cannot be handled successfully by the server, the server returns an exception message to the client. Transaction identifier of the exception message will be same as the transaction identifier of the request.

A server shall not respond with an exception to a UDP broadcast request, which does not contain its node identifier.

Figure 73 shows an exception for a request of a non-existent IDN.

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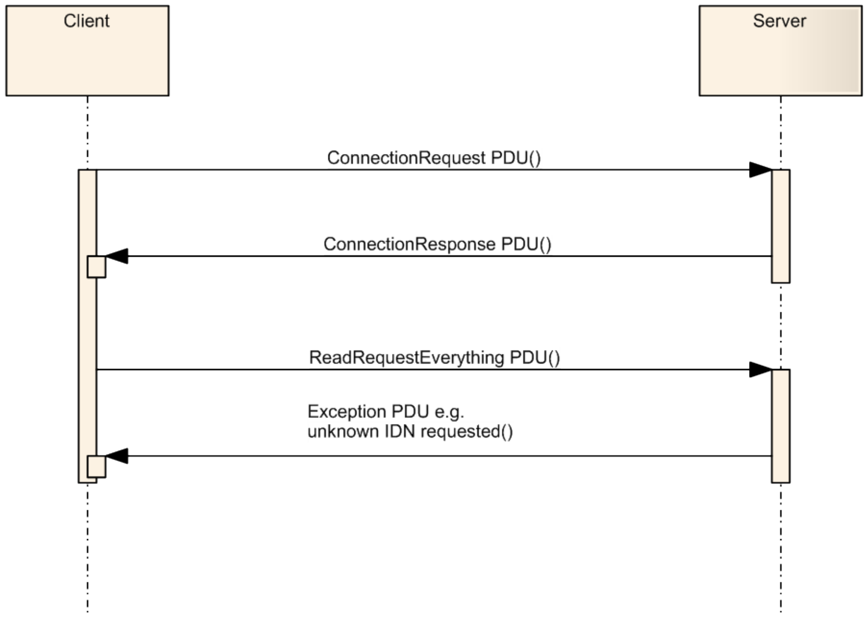

Figure 73 – S/IP error response

7.1.11.4.3.2 Exception structure

The exception message contains a common error code and an optional service specific error code.

```
struct Exception               // MessageType: 67

{

  uint16 CommonErrorCode;      // see enum below

  uint32 SpecificErrorCode;    // service specific error codes,

                               // e.g. error codes of service channel

}
```

7.1.11.4.3.3 Common error codes

```
enum CommonErrorCode

{

  CONNECTION_ERROR = 1,     // connection cannot be established

  TIMEOUT = 2,              // connection lost, timeout

  UNKNOWN_MESSAGE_TYPE = 3, // service not supported

  SERVICE_SPECIFIC = 4,     // service specific error

                            // --> see SpecificErrorCode for details

  PDU_TOO_LARGE = 5,        // request or response does not fit

                            // to the UDP datagram
```

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```
                          // (limitation of PDU size)

  PDU_PROTOCOL_MISMATCH = 6 // malformed PDU e.g. received UDP datagram does not

                          // correspond to the expected PDU size

}
```

NOTE For service specific error code definitions, refer to the corresponding S/IP services.

Table 103 lists the common error codes together with the context, in which they are used.

Table 103 – Common error codes

Error code	Context
CONNECTION_ERROR	If the server is not able to serve a TCP based S/IP connection. see TCP based communication initialization for further details.
TIMEOUT	If a timeout exceeds (see Timeouts for further details) or a TCP connection gets lost. Network activities are controlled by local timeout handling. If the server doesn't respond in time, this error code is used to indicate the error to the user on client-side.
UNKNOWN_MESSAGE_TYPE	If the server receives an unknown message type, it shall send an exception with this error code to the client. In case of a TCP based S/IP request the server returns the exception to the client and shall close the TCP stream socket connection.
SERVICE_SPECIFIC	Services are able to have their own error code. Further information is available in the SpecificErrorCode of the Exception structure. see also specific error code descriptions of the service invoked.
PDU_TOO_LARGE	This is an UDP specific error. see Limitations of PDU size for further details.
PDU_PROTOCOL_MISMATCH	This is an UDP specific error. E. g. the length of the received datagram is not conforming to the expected PDU size of the service. This error indicates an incompatible implementation.

7.1.11.5 Services

7.1.11.5.1 General

The following sections describe the services provided by S/IP.

The information, which services are supported by a device, can be obtained by one of the following mechanisms:

- as a part of the connect response if TCP based S/IP connections are used (see 7.1.11.5.2).
- the SupportedUDPServices service can be used to get a list of all UDP services supported by a device (see 7.1.11.5.7.1).

7.1.11.5.2 S/IP Connection Service

7.1.11.5.2.1 General

Are used to establish and maintain an S/IP connection using TCP based S/IP.

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7.1.11.5.2.2 Connect Service

This service can be used via the following transport protocol: TCP.

7.1.11.5.2.2.1 Connect Request

In order to initiate an S/IP connection, the client sends a ConnectRequest PDU to the server. This request contains the desired S/IP version number and desired timeout values for the connection.

```
struct Connect                  // MessageType: 63
{
 uint32 version;                // S/IP protocol version
                                // version=1 shall be used for this
                                // protocol version
 uint32 busyTimeout;            // requested busy-timeout in milliseconds,
                                // the server should use
 uint32 leaseTimeout;           // requested lease-timeout in milliseconds,
                                // the server should use
}
```

7.1.11.5.2.2.2 Connect Response

If the server is able to serve the connection, a ConnectResponse PDU shall be returned to the client. In the ConnectionResponsePDU, the server provides its protocol version and the busy timeout and lease timeout values that are active for this connection to the client. If the server cannot serve the desired version of the client, it shall respond with an available version number that is lower or equal than the desired version number.

Furthermore, the ConnectResponse PDU contains a list of services supported by the server.

```
struct ConnectResponse          // MessageType: 64
{
  uint32  version;              // S/IP protocol version
                                // version=1 is used for this
                                // protocol version
  uint32 busyTimeout;           // busy-timeout in milliseconds,
                                // the server is using
  uint32 leaseTimeout;          // lease-timeout in milliseconds,
                                // the server is using
                                // typically 10000 - 30000 msec
```

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```
  uint32 noMessageTypes;        // number of Request MessageTypes

  uint32 messagetypes[];        // The supported Request MessageTypes

                                // of the server on this TCP connection.

                                // The client must only use these

                                // message types in a request.

}
```

If the server is not able to serve the connection an Exception PDU shall be returned.

If the timeout values in the ConnectResponse PDU differs from the values of the ConnectRequest PDU, the client is responsible to adjust the timeout values to consider the delay times and reaction times of the application.

7.1.11.5.2.3 Ping Service

This service can be used via the following transport protocols: TCP, UDP (unicast).

If the server does not receive any message from the client before the lease timeout, it may close the connection to the client. The client may re-trigger the lease timeout in the server using the ping service.

7.1.11.5.2.3.1 Ping Request

```
struct Ping         // MessageType: 65

{

}
```

7.1.11.5.2.3.2 Ping Response

```
struct PingResponse // MessageType: 66  (pong)

{

}
```

7.1.11.5.3 Explore and IP Configuration Service

7.1.11.5.3.1 General

The following services are used to browse for devices within Type 19 networks and to configure their IP settings.

7.1.11.5.3.2 Browse service

This service can be used via the following transport protocol: UDP (broadcast).

The Browse service is used to detect devices within the same subnet.

Figure 74 shows the following sequence of the Browse services.

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- A software tool (client) sends a browse request as global UDP broadcast to the local network. Within this browse request it is possible to set filters so that not all local Type 19 devices (servers) need to send a response. Possible filters are:
  – Master only: Only devices those are communication masters on the local network shall respond.
  – Address range: Only devices those fit the desired Device address range shall respond.
- All the Type 19 devices (servers) which receives the browse request and meets the filter condition shall send a browse response. This response contains the information like device's current network configuration, FSP types and the name that easily identifies that device.

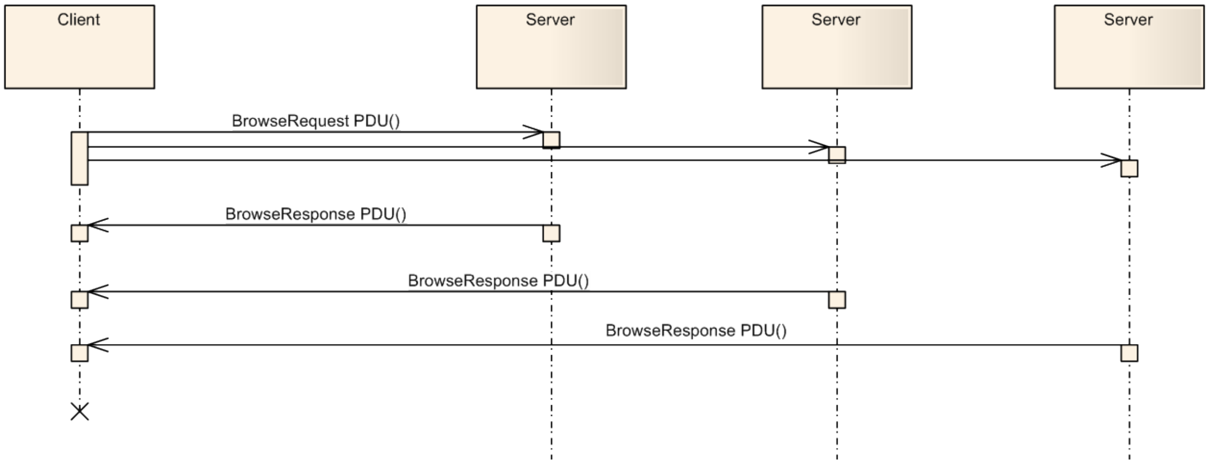

Figure 74 – UDP Browsing

7.1.11.5.3.2.1 Browse Request

```
struct Browse                  // MessageType = 91

{

                               // ipaddress of the sending node.

                               // The ip-address must correspond

                               // to the interface of the sender

  byte  ipaddress[4];          // [0] msb, [3] lsb

  bool  masterOnly;            // if != 0, only devices who have

                               // a Type 19 master interface

                               // shall reply


  uint16 lowerType19Address;   // Only devices with a Type 19 address

                               // between lower and upper bound shall

                               // reply.  If both values are 0, all

                               // devices shall reply. This filter
```

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```
                                // setting is not relevant for
                                // master devices.
  uint16 upperType19Address;
}
```

7.1.11.5.3.2.2 Browse Response

The BrowseResponse depends on the interface on which the BrowseRequest has been received. The interface specific items are MAC Address, DHCP Features, DHCP Mode, IP Address, Subnet and Gateway.

If the implementing service doesn't know the receiving interface, it should send a response for each interface over all interfaces.

Example: Consider a device having 2 interfaces, interface 1 and interface 2. In this case service should

- Send the response containing the information for interface 1 over interface 1 and interface 2 and
- Send the response containing the information for interface 2 over interface 1 and interface 2.

The client (the one which sent the browse request) should check the Node Identifier to detect multiple responses from a node.

```
struct BrowseResponse           // MessageType: 100
{
  uint32  version;              // S/IP protocol version
                                // version=1 is used for this
                                // protocol version
  byte node_identifier[6];      // node identifier
                                // 00:11:22:33:44:55 [0] = 00, [5] = 55
  byte macAddress[6];           // mac address of the interface from which
                                // the response has been sent.
                                // 00:11:22:33:44:55 [0] = 00, [5] = 55
  byte DHCPFeatures;            // bit[0]: dhcp client available
                                // bit[1]: dhcp server available
                                // bit[2]: dhcp relay agent available
  byte DHCPMode;                // 0: no dhcp a static IP address is used
                                // 1: dhcp client active
                                // 2: dhcp server active
```

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```
                                // 3: dhcp relay agent active
  byte ipaddress[4];            // [0] msb, [3] lsb
  byte subnet[4];               // [0] msb, [3] lsb
  byte gateway[4];              // ip address of responsible gateway
  uint32 dplength;              // length of display name in octets
  byte displayname[dplength];   // display name to identify the device
                                // in an browser
                                // length should not exceed 64 characters
  uint32 hnlength;              // length of hostname in octets
  byte hostname[hnlength];      // name to identify the node S-0-1039
}
```

If a server receives a request with an invalid PDU size, it shall ignore the message and shall not send an error exception.

The element "displayname" may contain information to uniquely identify the found device. It is supposed to be directly displayed as single information in a user interface. The displayname should not exceed 64 characters. It should be language neutral.

Examples:

- <device type> <serial number> --> "LXM62PS (12345678-0000)"
- <application type> <device identification number> <sudevice address> --> "AT:X-Achse ID:8a AD:12"

7.1.11.5.3.3 SetIP service

This service can be used via the following transport protocol: UDP (broadcast).

The SetIp service is used to set an IP configuration of an interface.

If DHCP client is enabled ipaddress, subnet and gateway are ignored.

Figure 75 shows the sequence for the network configuration service.

- A client sends a set IP configuration request as global UDP broadcast to the local network. The device to be configured is addressed using the node identifier. The request contains a complete IP configuration for the device. If the transmitted gateway address does not fit the transmitted network configuration, no default gateway shall be set (0.0.0.0). The new configuration can be set persistent or temporarily (until reboot). This is signaled by the field persistent in the request structure.
- The addressed Type 19 device shall either
  - – Respond with a set IP response message and activate the new network configuration. The order, in which both actions are executed, is not defined. That means, the set IP response may be send with the old or new IP configuration.
  - – Respond with an error message as UDP broadcast. This may be done if:
    - Device is in operational mode controlled by a Type 19 master or

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- Device does not support setting a temporary network configuration.

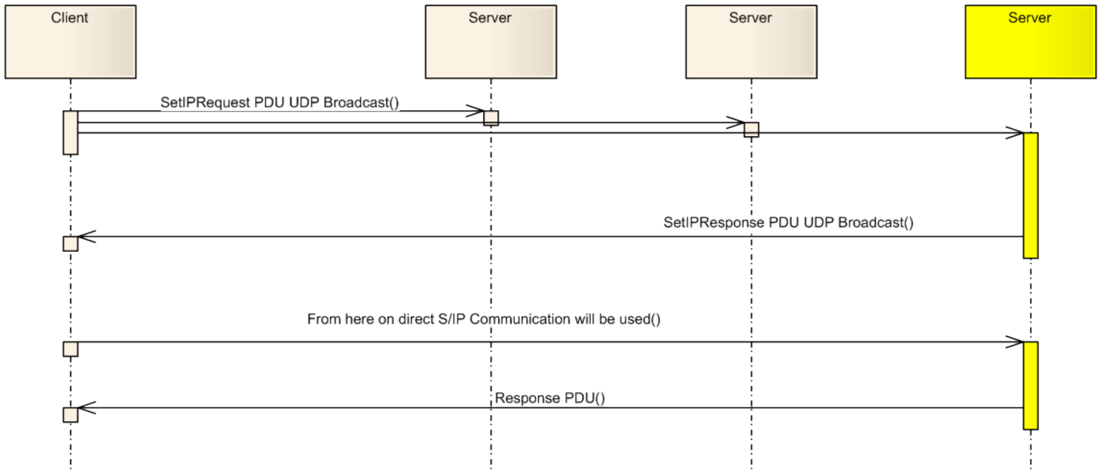

Figure 75 – Sequence of setting a new network configuration on one device using UDP

NOTE 1 Set the gateway element of the request to "0.0.0.0" to disable the gateway functionality.

NOTE 2 If the service is used for the slave interface, the settings should be reflected by the parameters: ipaddress (see S-0-1020 IP address), subnet (see S-0-1021 Subnet Mask), gateway (see S-0-1022 Gateway address).

7.1.11.5.3.3.1 SetIp Request

```
struct SetIp                // MessageType = 95

{                           // node identifier of the device

  byte node_identifier[6]; // 00:11:22:33:44:55 [0] = 00, [5] = 55

  byte macAddress[6];      // mac address of the interface.

                           // 00:11:22:33:44:55 [0] = 00, [5] = 55

  byte DHCPMode;           // 0: DHCP disabled

                           // 1: enable dhcp client

                           // 2: enable dhcp server

                           // 3: enable dhcp relay agent

  byte ipaddress[4];       // [0] msb, [3] lsb

                           // new subnet mask

  byte subnet[4];          // [0] msb, [3] lsb

                           // default gateway to forward ip messages

  byte gateway[4];         // [0] msb, [3] lsb

  bool persistent;         // if != 0, store settings persistent

  uint32 hnlength;         // length of hostname in octets
```

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```
  byte hostname[hnlength]; // name to identify the node (see S-0-1039)
}
```

7.1.11.5.3.3.2 SetIp Response

```
struct SetIpResponse       // MessageType = 96
{
}
```

In case of an error an Exception SDU containing an error code will be sent.

```
enum SetIpErrorCode
{
  INVALID_DEVICE_STATE = 1      //  invalid device state
                                // (IP  configuration cannot be activated)
  TEMP_IP_NOT_SUPPORTED  = 2    // temporary IP configuration is
                                // not supported
  INVALID_SERVICE_DATA  = 3     // The given data are incorrect
  SET_IP_NOT_SUPPORTED  = 4     // setting of static IP_ address
                                // is not supported
  INVALID_DHCP_MODE  = 5        // device does not support DHCP_MODE
}
```

7.1.11.5.3.4 Interfaces service

This service can be used via the following transport protocols: TCP, UDP (unicast).

This service gets all the interfaces of a node.

7.1.11.5.3.4.1 Interfaces Request

```
struct Interfaces                // MessageType = 103
{
}
```

7.1.11.5.3.4.2 Interfaces Response

```
struct InterfacesResponse       // MessageType = 104
{
  byte node_identifier[6];      // 00:11:22:33:44:55 [0] = 00, [5] = 55
  uint32 dplength;              // length of display name in octets
```

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```
  byte displayname[dplength];   // display name to identify the device
                                // in an browser, see BrowseRespone
                                // length should not exceed 64 characters
  uint32 noInterfaces;          // number of interfaces
  struct
  {
    byte macAddress[6];    // mac address of the interface 00:11:22:33:44:55 [0] = 00,
[5] = 55
    byte ipAddress[4];    // [0] msb, [3] lsb ipaddress of the slave interface
    byte interfaceType;   // 0: an Ethernet interface, e. g. engineering port
                          // 1: a Type 19 Slave interface
                          // 2: a Type 19 Master interface
  } interfaces[noInterfaces];
}
```

7.1.11.5.3.5 Slaves service

This service can be used via the following transport protocols: TCP, UDP (unicast).

This service gets all slaves connected to a master interface. Only Type 19 masters have to implement this service.

7.1.11.5.3.5.1 Slaves Request

```
struct Slaves                       // MessageType = 105
{
  byte macAddress[6];               // mac address of the master interface
                                    // 00:11:22:33:44:55 [0] = 00, [5] = 55
}
```

7.1.11.5.3.5.2 Slaves Response

```
struct SlavesResponse         // MessageType = 106
{
  uint32 noSlaves;            // number of slaves
  struct
  {
    byte ipaddress[4];        // [0] msb, [3] lsb ipaddress of the slave
```

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```
    byte node_identifier[6];  // 00:11:22:33:44:55 [0] = 00, [5] = 55
  } slaves[noSlaves];
}
```

In case of an error an Exception SDU containing an error code will be sent.

```
enum SlavesErrorCode
{
  INVALID_MAC_ADDRESS = 1      // Interface MAC address is not valid
                               // for Slaves service
}
```

7.1.11.5.3.6 BrowseOnSlaveInterface Interface

This service can be used via the following transport protocols: TCP, UDP (unicast).

This service requests the master to browse on another slave interface for masters. Only Type 19 masters have to implement this service. This service allows a slave of ring1 to get information from its master (ring1) from another ring (ring2). The node, master of ring1, must be a slave of ring2. Browse responses are collected by the server for a duration of timeToBrowse. After timeToBrowse the server will report the collected responses to the client.

7.1.11.5.3.6.1 BrowseOnSlaveInterface Request

```
struct BrowseOnSlaveInterface       // MessageType = 107
{
  byte macAddress[6];               // macAddress of the slave interface
                                    // to browse for masters
  int32 timeToBrowse;               // time to wait for responses in
                                    // milliseconds
}
```

7.1.11.5.3.6.2 BrowseOnSlaveInterface Response

```
struct BrowseOnSlaveInterfaceResponse // MessageType = 108
{
  uint32 noMasters;                   // number of masters
  struct
  {
    byte node_identifier[6];   // master node identifier
                               // 00:11:22:33:44:55 [0] = 00, [5] = 55
```

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```
    byte ipaddress[4];         // master ip address
                               // [0] msb, [3] lsb ipaddress
                               // of the slave
  } masters[noMasters];
}
```

In case of an error an Exception SDU containing an error code will be sent.

```
enum BrowseOnSlaveInterfaceErrorCode
{
  INVALID_MAC_ADDRESS = 1      // Interface MAC address is not valid
                               // for Slaves service
}
```

7.1.11.5.4 Identification Services

7.1.11.5.4.1 General

The following services allow the identification of S/IP devices.

7.1.11.5.4.2 Identify service

This service can be used via the following transport protocol: UDP (broadcast).

The Identify service is used for the identification of a device, by instructing the device to identify itself, for example blinking.

Figure 76 shows the sequence of the UDP identify service.

- A client sends an identify request as global UDP broadcast to the local network. The device to be identified is addressed using the node identifier in the identify request.
- The addressed Type 19 device shall identify itself, the device signals for 4 seconds. After that, signaling is stopped automatically. The signaling LED behavior is defined in the section Type 19_LED. Identified device shall also send an identify response.

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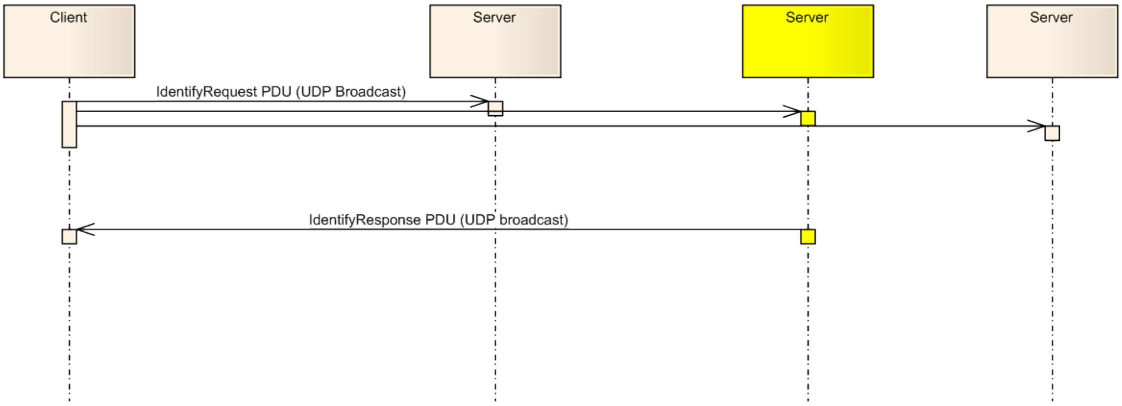

Figure 76 – UDP Identification

7.1.11.5.4.2.1 Identify Request

```
struct Identify            // MessageType = 93

{

                           // node identifier of the device

  byte node_identifier[6]; // 00:11:22:33:44:55 [0] = 00, [5] = 55

}
```

7.1.11.5.4.2.2 Identify Response

Only the addressed device sends a response.

```
struct IdentifyResponse    // MessageType = 94

{

}
```

7.1.11.5.4.3 Nameplate service

This service can be used via the following transport protocols: TCP, UDP (unicast).

The nameplate service requests the electronic nameplate of the node. The nameplate information is returned as a list of nameplate entries. Each entry contains a leading id and a string value. The ids are defined in Table 104. If not explicitly defined, the display format of the string value is given by the attribute of the referred IDN.

7.1.11.5.4.3.1 Nameplate Request

```
struct Nameplate                   // MessageType = 89

{

}
```

7.1.11.5.4.3.2 Nameplate Response

```
struct NameplateResponse           // MessageType = 90
```

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```
{
  uint32 noEntries;                // number of nameplate entries
  struct
  {
     byte id;                      // id of the nameplate entry
     uint32 length;                // length of value in octets
     byte[length] value;           // value of the nameplate entry:
                                   // string Variable-Len
  } nameplate_entries[noEntries];
}
```

Table 104 – Nameplate IDs

ID	Name	Comments
1	reserved	
2	Vendor name	refers to S-0-1300.x.02 Vendor Name
3	Type 19 Vendor code	refers to S-0-1300.x.03 Vendor Code
4	Device name	refers to S-0-1300.x.04 Device Name
5	Vendor device ID	refers to S-0-1300.x.05 Vendor Device ID
6	(reserved)	
7	Function Revision	refers to S-0-1300.x.07 Function Revision
8	HW Revision	refers to S-0-1300.x.08 Hardware Revision
9	FW Revision	refers to S-0-1300.x.09 Software Revision
10	Firmware loader revision	refers to S-0-1300.x.10 Firmware Loader Revision
11	(reserved)	
12	Serial number	refers to S-0-1300.x.12 Serial Number
13	Manufacturing Date	refers to S-0-1300.x.13 Manufacturing Date
14 ...19	(reserved)	
20	Operational Hours	refers to S-0-1300.x.20 Operational Hours
21 ... 31	(reserved)	
32	Hostname	refers to S-0-1039 Hostname
33	Quantity of slaves	refers to the number of list elements of S-0-1046 List of sub-device addresses in device the display format shall unsigned decimal
34 ... 127	(reserved)	
128 ... 255	Manufacturer-specific	

7.1.11.5.4.4 NameplateBroadcast service

This service can be used via the following transport protocol: UDP (broadcast).

The NameplateBroadcast service is used to gather information about a device.

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The NameplateResponse returns a list of IDN parameters. It may be used for additional info about devices without defined communication settings.

```
struct NameplateBroadcast  // MessageType = 99

{                          // node identifier of the device

  byte node_identifier[6]; // 00:11:22:33:44:55 [0] = 00, [5] = 55

}
```

The response is defined in Nameplate Service.

7.1.11.5.5 Parameter Access

7.1.11.5.5.1 General

In most cases a Type 19 device will have only one interface and hence only one IP address. To access the parameters (reading and writing parameters) from different slaves of a device, slaves need to be addressed in the request. This addressing will be done using slave index. The slave-index is an internal numeration of all slaves in a device.

The number of slaves in one device corresponds to the number of elements in the global parameter S-0-1046. Absence of parameter S-0-1046 indicates that the device has exactly one slave. In this case zero shall be used for slave index. Global parameters are available with any slave index.

A device may define additional parameters using the Type 19 parameter structure. These parameters are accessible by the SlaveExtension. If not used, the SlaveExtension should be zero.

7.1.11.5.5.2 Parameter data

The coding of the parameter data including the min and max value corresponds to the coding of the service channel with some exceptions described below:

- Coding is done in little endian
- The length of the value is given with the attribute size of (1,2,4,8) in octets.
- Parameter with string as data uses lists of 1 byte elements. The length of the parameter data represents the coding length of the string in octets, not the number of characters. There is no terminating 0 byte. Strings are coded in utf-8.
- Lists:
  – The list header which contains the maximum length and the current length is not part of the S/IP data. Only list element value data's are part of the transmitted information.
  – The current length of the list will be returned by the datalength. The number of elements in the list may be evaluated using the element size information of the attribute and the datalength.
  – Use ReadEverything or ReadDescription to get the maximum available list size in octets.

7.1.11.5.5.3 IDNs

IDNs are passed in the services to address a specific parameter. IDNs are also part of the parameter value, if the parameter display format is "IDN". see the IDN specification how to code and decode the IDN.

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7.1.11.5.5.4 Parameter service specific error codes

The following enumeration defines the service specific error codes for S/IP. see also the SVC error codes

```
enum SipErrorCode

{

  // 0x0 - 0x7FFFFFFF                    // reserved for SVC Error Codes,

                                         //  e.g. 0x1001 No IDN

  // > 0x80000000                        // Addition Error Codes

  SLAVE_INDEX_INVALID      = 0x80000001,

  PARAMETER_INVALID        = 0x80000002, // can be used to avoid invalid access;

                                         // e.g. write access to procedure commands

  PARAMETER_NOT_ACCESSIBLE = 0x80000003, // Parameter cannot be accessed

                                         // e.g. if parameter database is not ready

}
```

7.1.11.5.5.5 ReadEverything Service

This service can be used via the following transport protocols: TCP, UDP (unicast).

7.1.11.5.5.5.1 ReadEverything Request

```
struct ReadEverything          // MessageType: 69

{

  uint16 SlaveIndex;

  uint16 SlaveExtension;

  uint32 IDN;

}
```

7.1.11.5.5.5.2 ReadEverything Response

```
struct ReadEverythingResponse  // MessageType: 70

{

  uint16   validelements;  // bitmask of the following elements,

                           // which are valid in this response

                           // invalid length elements shall be set to 0

                           // bitmask | description

                           // -------------------------------------------------
```

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```
  uint16   data_status;    // 0x01    | data valid & command
                           //         | acknowledge ref. IDN numbers
  uint16   namelength;     // 0x02    | length of datablock element 2 in octets
  uint32   attribute;      // 0x04    | datablock element 3
  uint16   unitlength;     // 0x08    | length of datablock element 4 in octets
  byte[8]  min;            // 0x10    | datablock element 5
  byte[8]  max;            // 0x20    | datablock element 6
  uint32   maxlistlength;  // --      | maximum length of datablock element 7
                           //         | in octets. Valid if parameter is a list
  uint32   datalength;     // 0x40    | length of datablock element 7 in octets
  byte[namelength] name;   // 0x02    | name of parameter; string Variable-Len
  byte[unitlength] unit;   // 0x08    | unit of parameter; string Variable-Len
  byte[datalength] data;   // 0x40    | datablock element 7
}
```

The response shall contain all implemented elements of the IDN.

7.1.11.5.5.6 ReadyOnlyData service

This service can be used via the following transport protocols: TCP, UDP (unicast).

7.1.11.5.5.6.1 ReadyOnlyData Request

```
struct ReadOnlyData            // MessageType: 71
{
  uint16 SlaveIndex;
  uint16 SlaveExtension;
  uint32 IDN;
}
```

7.1.11.5.5.6.2 ReadyOnlyData Response

```
struct ReadOnlyDataResponse    // MessageType: 72
{
  uint32 attribute;
  uint32 length;               // length of data counted in octets
  byte[length] data;
```

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```
}
```

7.1.11.5.5.7 ReadDescription service

This service can be used via the following transport protocols: TCP, UDP (unicast).

7.1.11.5.5.7.1 ReadDescription Request

```
struct ReadDescription         // MessageType: 73

{

  uint16 SlaveIndex;

  uint16 SlaveExtension;

  uint32 IDN;

}
```

7.1.11.5.5.7.2 ReadDescription Response

```
struct ReadDescriptionResponse // MessageType: 74

{

  uint16   validelements;  // bitmask of the following elements,

                           // which are valid in this response

                           // invalid length elements shall be set to 0

                            // bitmask | description

                           // -------------------------------------------------

  uint16   namelength;     // 0x02    | length of datablock element 2 in octets

  uint32   attribute;      // 0x04    | datablock element 3

  uint16   unitlength;     // 0x08    | length of datablock element 4 in octets

  byte[8]  min;            // 0x10    | datablock element 5

  byte[8]  max;            // 0x20    | datablock element 6

  uint32   maxlistlength;  // --      | maximum length of datablock element 7

                           //         | in octets. Valid if parameter is a list

  byte[namelength] name;   // 0x02    | name of parameter; string Variable-Len

  byte[unitlength] unit;   // 0x08    | unit of parameter; string Variable-Len

}
```

NOTE The response has to contain all implemented elements of the IDN.

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7.1.11.5.5.8 ReadDataStatus service

This service can be used via the following transport protocols: TCP, UDP (unicast).

7.1.11.5.5.8.1 ReadDataStatus Request

```
struct ReadDataStatus         // MessageType: 87
{
  uint16 SlaveIndex;
  uint16 SlaveExtension;
  uint32 IDN;
}
```

7.1.11.5.5.8.2 ReadDataStatus Response

```
struct ReadDataStatusResponse // MessageType: 88
{
  uint16   data_status;        // data valid & command acknowledge
                               // refer to the IDN numbers
}
```

7.1.11.5.5.9 ReadSegment service

This service can be used via the following transport protocols: TCP, UDP (unicast).

This service reads operation data elements. The response length depends on the data type.

7.1.11.5.5.9.1 ReadSegment Request

```
struct ReadSegment                  // MessageType: 109
{
  uint16 SlaveIndex;
  uint16 SlaveExtension;
  uint32 IDN;
  uint16 StartIndex;                // 0 based index of the first
                                    // list element
  uint16 NumberOfRequestedElements; // requested number of list elements
}
```

7.1.11.5.5.9.2 ReadSegment Response

```
struct ReadSegmentResponse          // MessageType: 110
```

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```
{
  uint32 attribute;
  uint16 NumberOfAvailableElements;  // Number of listelements
  uint32 length;                     // length of data counted
                                     // in octets
  byte[length] data;                 // parameter data
}
```

The device may return fewer elements than requested. Response having fewer elements indicates that the MTU size can be too small or the end of the list is reached.

If the start index of the request is out of range, the server shall reply with the data length of zero.

IDNs with a fix length shall be treated as list IDNs with length 1.

7.1.11.5.5.10 WriteName service

This service can be used via the following transport protocols: TCP, UDP (unicast).

7.1.11.5.5.10.1 WriteName Request

```
struct WriteName              // MessageTypes: 75
{
  uint16          SlaveIndex;
  uint16          SlaveExtension;
  uint32          IDN;
  uint16          namelength;
  byte[namelength] name;      // string Variable-len */;
}
```

7.1.11.5.5.10.2 WriteName Response

```
struct WriteNameResponse      // MessageTypes: 76
{
                              // empty response; data was written correctly
                              // in case of an error, an exception will be
                              // sent instead
}
```

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7.1.11.5.5.11 WriteAttribute service

This service can be used via the following transport protocols: TCP, UDP (unicast).

7.1.11.5.5.11.1 WriteAttribute Request

```
struct WriteAttribute          // MessageType: 77

{

  uint16  SlaveIndex;

  uint16  SlaveExtension;

  uint32  IDN;

  uint32  attribute;

}
```

7.1.11.5.5.11.2 WriteAttribute Response

```
struct WriteAttributeResponse  // MessageTypes: 78

{

                               // empty response; data was written correctly

                               // in case of an error, an exception will be

                               // sent instead

}
```

7.1.11.5.5.12 WriteUnit service

This service can be used via the following transport protocols: TCP, UDP (unicast).

7.1.11.5.5.12.1 WriteUnit Request

```
struct WriteUnit               // MessageType: 79

{

  uint16           SlaveIndex;

  uint16           SlaveExtension;

  uint32           IDN;

  uint16           unitlength;

  byte[unitlength] unit;       // string with var-len

}
```

7.1.11.5.5.12.2 WriteUnit Response

```
struct WriteUnitResponse     // MessageType: 80
```

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```
{
                             // empty response; data was written correctly
                             // in case of an error, an exception will be
                             // sent instead
}
```

7.1.11.5.5.13 WriteMinMax service

This service can be used via the following transport protocols: TCP, UDP (unicast).

7.1.11.5.5.13.1 WriteMinMax Request

```
struct WriteMinMax           // MessageType: 81
{
  uint16  SlaveIndex;
  uint16  SlaveExtension;
  uint32  IDN;
  byte[8] min;               // datablock element 5
  byte[8] max;               // datablock element 6
}
```

7.1.11.5.5.13.2 WriteMinMax Response

```
struct WriteMinMaxResponse   // MessageType: 82
{
                             // empty response; data was written correctly
                             // in case of an error, an exception will be
                             // sent instead
}
```

7.1.11.5.5.14 WriteData service

This service can be used via the following transport protocols: TCP, UDP (unicast).

7.1.11.5.5.14.1 WriteData Request

```
struct WriteData             // MessageType: 83
{
  uint16  SlaveIndex;
  uint16  SlaveExtension;
```

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```
  uint32  IDN;
  uint32  length;          // length of data counted in octets
  byte[length] data;
}
```

7.1.11.5.5.14.2 WriteData Response

```
struct WriteDataResponse     // MessageType: 84
{
                             // empty response; data was written correctly
                             // in case of an error, an exception will be
                             // sent instead
}
```

7.1.11.5.5.15 WriteDataBits service

This service can be used via the following transport protocols: TCP, UDP (unicast).

7.1.11.5.5.15.1 WriteDataBits Request

```
struct WriteDataBits         // MessageType: 85
{
  uint16  SlaveIndex;
  uint16  SlaveExtension;
  uint32  IDN;
  uint32  length;            // length of data and mask counted in octets
  byte[length] data;         // value of bits to be modified
  byte[length] dataMask;     // bits to be modified
}
```

If the length sent by the client is less than the size of the parameter, the server shall extend the MSB of mask and value with 0 octets.

NOTE WriteDataBits is supported only for non-list parameters.

7.1.11.5.5.15.2 WriteDataBits Response

```
struct WriteDataBitsResponse // MessageType: 86
{
                             // empty response; data was written
                             // correctly in case of an error, an
```

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```
                                    // exception will be sent instead

}
```

7.1.11.5.6 Device Management Services

7.1.11.5.6.1 Reset service

This service can be used via the following transport protocol: UDP (broadcast).

The Reset service is used to reset one or more devices in a network.

Since the reset service is going to interrupt the communication, the reset has to be delayed by the server. The devices which shall participate in the reset are identified by the node_identifiers. As soon as a reset request has been received at a device, it shall start an internal timer and after the timeout time has elapsed, reset will be performed. Because of possible data losses, it is recommended that the client repeats the request up to five times with a gap of ~100 ms between the requests. If a server receives a reset request twice, the timer shall be restarted. If there is any situation which does not allow the execution of the reset request, for example safety conditions, the reset request shall be ignored by the device.

The maximum number of devices which can be addressed by a reset request is restricted to 85. This is because of restriction on UDP packet size. If there are more than 85 devices which should be restarted, it is possible to send different reset requests consecutively.

This service shall perform a cold reset. The main purpose of this service is activating the depending update files, transferred for example via TFTP.

NOTE Devices will not send any response to this request.

7.1.11.5.6.1.1 Reset Request

```
struct Reset                                    // MessageType = 97

{

  uint32 timeout;                               // waiting time in milliseconds

                                                //  until  reset  is  performed  by  the
device

  uint16 no_node_identifiers;                      // number of node_identifiers inside
range

                                                // from 0 to 85. If 0, no device shall

                                                // perform a reset,

                                                // else the amount of node_identifiers

  byte node_identifier[no_node_identifiers][6]; // Array of node_identifiers:

                                                // 00:11:22:33:44:55 [0] = 00, [5] = 55

}
```

Figure 77 shows the usage of UDP ResetRequest. A client tool is used to send two reset requests. The first request intends to reset the first and the third device. After the request has been sent, the user wants to reset the second device, too. Therefore, the client tool sends a

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second request which addresses the second device only. After the timeout time has elapsed, the devices perform the hardware reset.

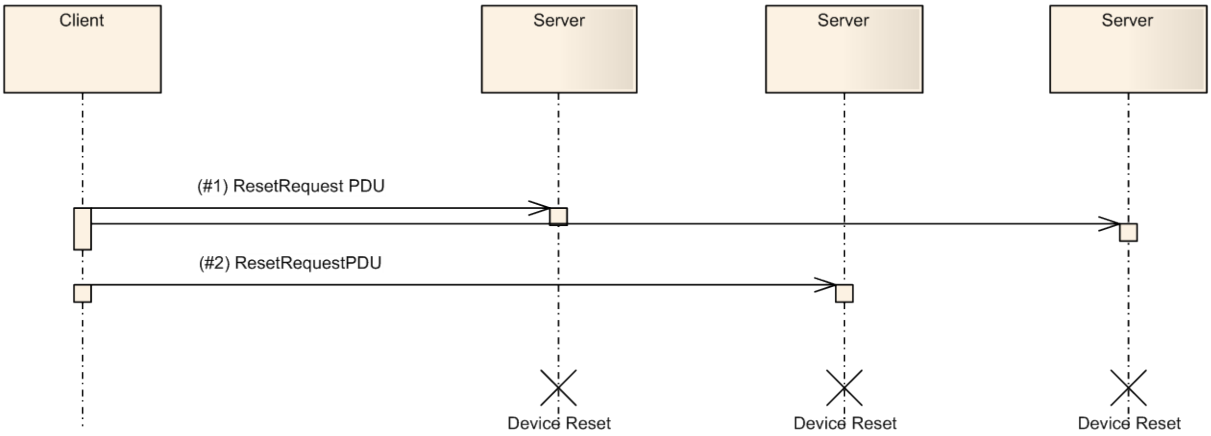

Figure 77 – Usage UDP reset request

NOTE Figure 77 does not show the recommended repetition of the sent requests.

7.1.11.5.6.2 TFTP Firmware Management / Update

This service can be used via the following transport protocol: TFTP.

- Firmware management uses the TFTP protocol.
- Any error shall be responded using the TFTP error messages, for example wrong firmware version including a describing error message. TFTP error messages shall not be used for a successful operation.

An overall activation of a new firmware shall be invoked using the reset service.

7.1.11.5.7 Other Services

7.1.11.5.7.1 SupportedUDPServices Services

This service can be used via the following transport protocol: UDP (unicast).

This service returns a list of all supported "UDP based S/IP" services (unicast and broadcast).

7.1.11.5.7.1.1 SupportedUDPServices Request

```
struct SupportedUDPServices         // MessageType: 61

{

}
```

7.1.11.5.7.1.2 SupportedUDPServices Response

```
struct SupportedUDPServicesResponse // MessageType: 62

{

  uint32 noMessageTypes;            // number of Request MessageTypes

  uint32 messagetypes[];            // The supported request
```

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```
                                              // MessageTypes of the server
                                              // The client shall only use
                                              // these message types in a request.
}
```

7.1.11.5.7.2 Watchdog Services

This service can be used via the following transport protocols: TCP, UDP (unicast).

This service implements a keep alive mechanism for an activity. This can be used to ensure an "in time termination" of specific activities of the device, started by the client.

While the specific activity is being executed by the device, the client shall keep on triggering the watchdog to keep the activity running. With this mechanism, device will come to know that the client is still alive and observing the activity being executed. If the device does not receive watchdog request before the timeout, due to any communication problems, the device will stop the specific activity automatically. Refer to Figure 78 for details.

Example: This service should be used to terminate an axis movement initiated by S/IP client.

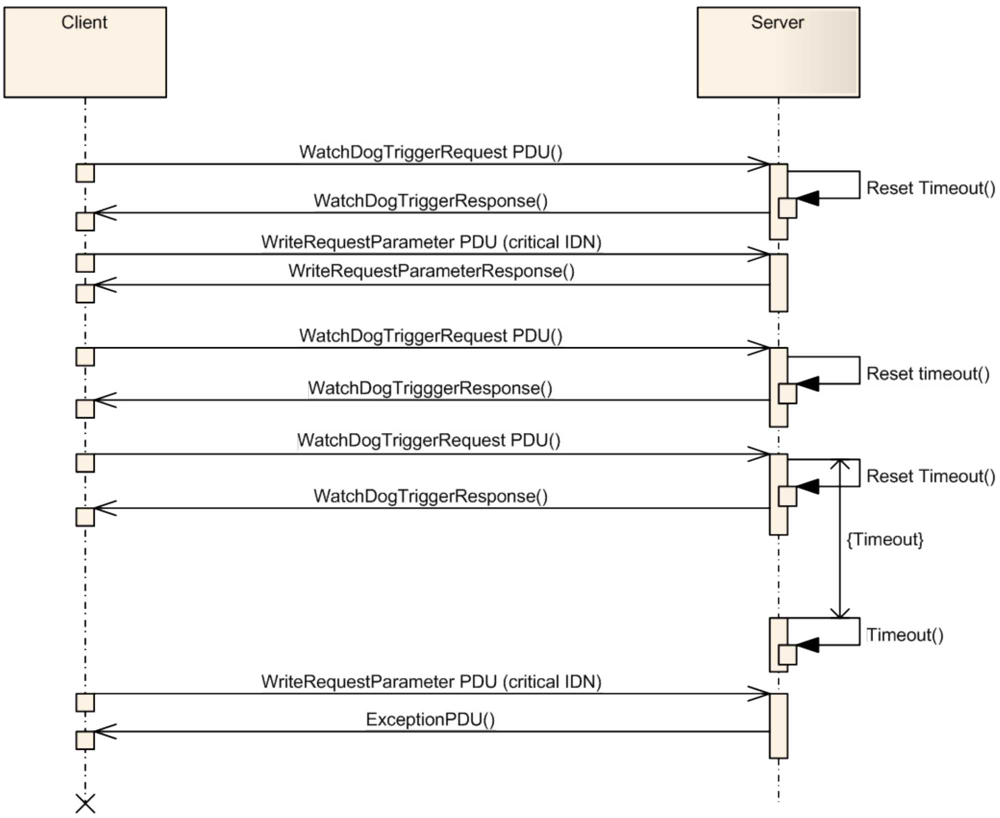

Figure 78 – Sequence for watchdog trigger service and client application timeout

This service message shall always be transmitted if an axis is moved using parameter access over S/IP. If this service message is not transmitted by the server for a dedicated time, a watchdog shall trigger and put the device into a safe state.

Since S/IP is only there to transport the data, functional safety cannot be provided by S/IP when moving axes. The definition of a safe state as well as the timeout values are dependent on the device and cannot be specified by S/IP.

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As an example, critical IDNs like S-0-0134 on drives shall only be writable, as long as the watchdog has not expired. After the watchdog has expired which is the initial state of the watchdog, all critical IDNs shall be reset to fall back values. Every device needs to know its critical IDNs by itself. If the watchdog has expired and a critical IDN should be written, the SVC error message 0x700c, „Operation data is write protected, due to other settings. (for example, parameter, operation mode, drive enable, drive on etc.)“, shall be responded.

The request message received by a device resets the devices watchdog. The device will reply to the request with a response message including the expiration period of the watchdog in milliseconds, refers to Watchdog trigger service.

7.1.11.5.7.2.1 Watchdog Request

```
struct WatchdogTrigger         // MessageType: 101

{

}
```

7.1.11.5.7.2.2 Watchdog Response

```
struct WatchdogTriggerResponse // MessageType: 102

{

  uint32 timeout;              // in milliseconds

}
```

7.1.11.6 Classification

Type 19 defines several IPS classes that may be implemented by the devices.

If a device supports a class, all services of that class shall be implemented. Table 105, Table 106, Table 107, Table 108, Table 109 and Table 110 show the mandatory services for master and slaves. Table 105 shows the defined Internet protocol classes.

Table 105 – IPS classes

Class IDs	Class name	Comments
1	TCP Basic	
2	UDP Basic	
3	Device Management	
4	Explore & IP Configuration Services	
5	Type 19 Parameter access	

At least one of the classes TCP Basic or UDP Basic (see Table 106 and Table 107) shall be implemented.

Table 106 – Class TCP Basic

Service	If UDP is supported	If TCP is supported
Connect	-	X
Ping	-	X
Busy	-	X

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Nameplate	-	X

Table 107 – Class UDP Basic

Service	If UDP is supported	If TCP is supported
Nameplate	X	-
SupportedUdpServices	X	-

Table 108 – Class Device Management

Service	If UDP is supported	If TCP is supported
TFTP Firmware Update	X	X

Table 109 – Explore & IP Configuration Services

Service	If UDP is supported	If TCP is supported
Browse	X	-
SetIpConfiguration	X	-
Identify	X	-

Table 110 – Class Type 19 Parameter Access

Service	If UDP is supported	If TCP is supported
ReadEverything	X	X
ReadOnlyData	X	X
ReadDescription	X	X
ReadDataStatus		X
ReadSegment	X	
WriteData	X	X
WriteDataBits	X	X

7.2 Synchronization

7.2.1 Network synchronization

7.2.1.1 General

The synchronization shall be used for synchronizable slaves which supports SCP_Sync only and consists of several functions.

- Compensation of the physical delay times (tring).
- Determination of the synchronization reference time (TSref) related to ring delay.
- Trigger of synchronization with end of MST (TTref).
- Determination of the optimal synchronization time (TSync) related to the processing times in the slaves.

The master shall measure the physical delay times (tring) in CP0, CP1 or CP2 as specified in this clause. The master shall transmit the S-0-1015 Ring delay to all synchronizable slaves. The master may measure also the physical delay times in CP4 for monitoring and diagnosis purposes.

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Then the slaves shall calculate its internal synchronization timing (S-0-1016 Slave delay (P&S)). This synchronization time and all times derived from it in the slave shall be activated with the S-0-1024 SYNC delay measuring procedure command.

Synchronization shall be generated once per communication cycle by a valid MST only (see Figure 79). The MST is protected via an additional CRC. The end of the MST is the synchronization trigger (TTref) in every communication cycle (see Figure 80).

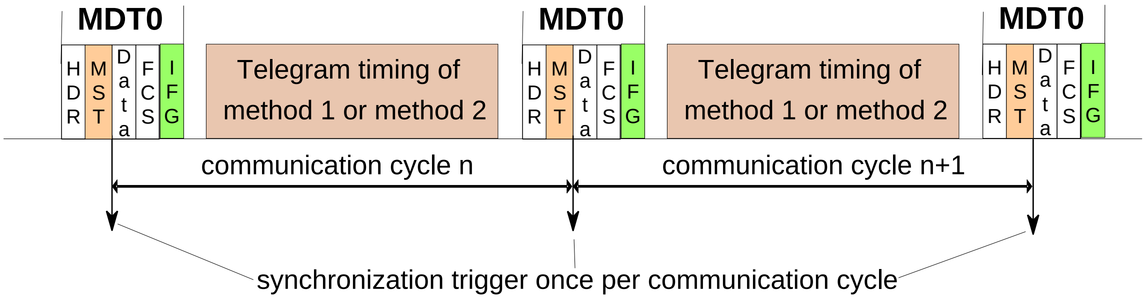

Figure 79 – Synchronization timing

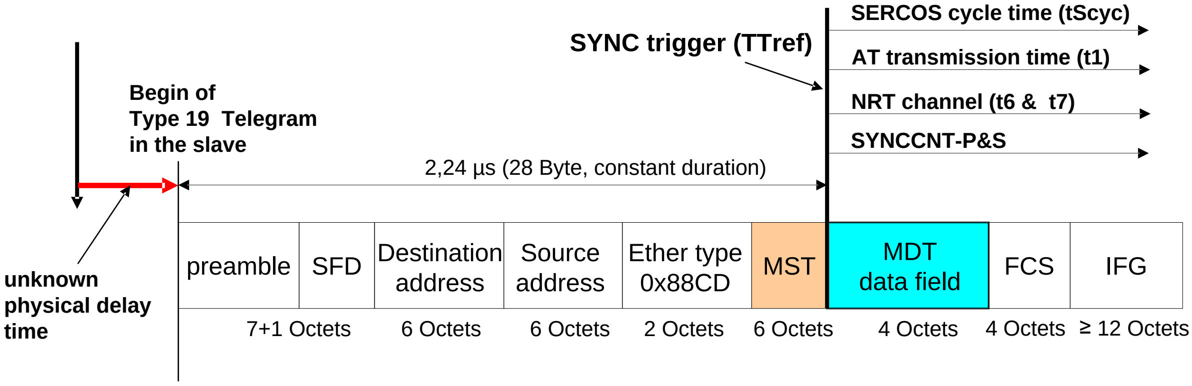

Figure 80 – Synchronization trigger

7.2.1.2 Ring delay acquisition procedure in the master

7.2.1.2.1 General

The master shall send MDTs cyclically as soon as it leaves NRT state for initializing the communication (CP0 to CP4). It shall then start sending MDT0 frames at the beginning of each communication cycle, within a jitter tolerance (MST jitter). The S-0-1023 SYNC jitter includes the MST jitter.

The ring delay acquisition procedure is the same for ring and for line topology. The master shall continuously monitor the results and compare them with the corresponding values that have been obtained during the last previously achieved ring delay acquisition procedure. It shall be able to issue warnings if any measured physical delay time differs from a previously obtained value by more than application dependent value and tolerance.

The master shall complete the ring delay acquisition procedure before it transmits the parameter S-0-1015 Ring delay to the slaves.

In addition, depending upon application, the master may activate it at any time during CP3 or CP4, i.e. for stability verification purposes, or when it detects topology changes (removing slaves, hot plugging slaves, ring recovery, etc.).

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For the ring delay acquisition procedure the master performs the following features:

- measure the physical delay time (tRing) of the given topology,
- compute the parameter S-0-1015 Ring delay,
- transfer the parameter S-0-1015 Ring delay to each synchronizing slave,
- activate the S-0-1024 SYNC delay measuring procedure command in each synchronizing slave.

The following timing parameters shall be characteristics of the network:

- trep – time by which the received signal shall be delayed by a Type 19 interface in fast forward and loopback with forward (input to output, approx. 600 ns);
- tcable – time by which the transmitted signal is actually delayed by a cable (CAT5 max. 5,56 ns per meter; glass fiber max. 5 ns per meter);
- tRing – average of the physical delay times measured by the master: $\mathrm{tRing} = \sum \mathrm{tcable} + \sum \mathrm{trep}$
- IFG jitter – dependent of the participants in the topology, the master shall determine the IFG jitter (see S-0-1036 Inter Frame Gap);
- Extra delay – additional delay defined or calculated by the master (for example in case of hot-plugging slaves, delay times of the master hardware, etc).

7.2.1.2.2 Determination of ring delay with topology line and ring

In topology line and ring the master shall use the same formula. In line is either P channel or S channel available. Both channels (P and S) are available in ring. Timing in master and slave, see Figure 81.

- The master shall measure at least 64 times the physical delays of the P channel (primary) and / or S channel (secondary) and determines the average (tRing) of all measurements.
- The master shall determine the IFG jitter dependent of the participants in the topology.
- The master may add an extra delay.
- The Master calculates the ring delay for a given line or ring topology using the following formula: S-0-1015 Ring delay = tRing + IFG jitter + extra delay.

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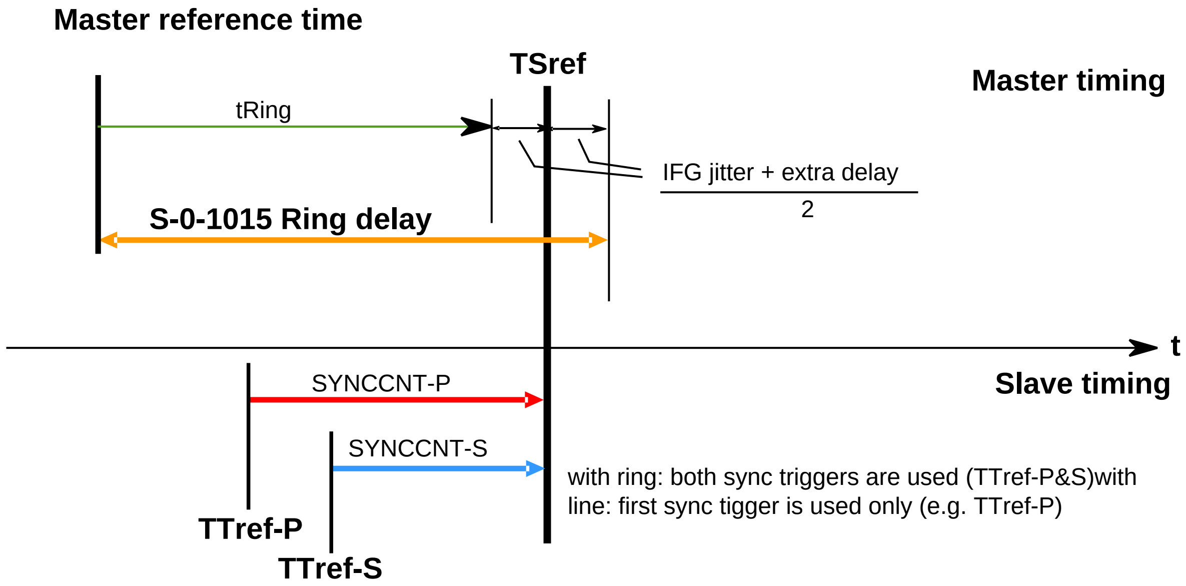

Figure 81 – Timing of TSref with ring and line

7.2.1.2.3 Determination of ring delay with interrupted ring topology

This calculation is only necessary in CP2 if the master shifts up with an interrupted ring from CP0 to CP4 and closes the ring in CP4. In this case the master shall determine two S-0-1015 Ring delay separately. One for the P channel, the other for the S channel. This shall be done to keep the TSref time synchronous of the P channel and S channel.

- The master shall measure at least 64 times the physical delays of the P channel and S channel and determines the average (tRing_P/S) separately.
- The master shall determine the IFG jitter dependent of the participants of the P channel and S channel separately (IFG jitter_P/S).
- The Master shall calculate the extra delay_P/S to keep the TSref time synchronous of the P channel and S channel of an interrupted ring. The following formula is used:

  tRing_P+(IFGjitter_P+extra delay_P)/2 = tRing_S+(IFG jitter_S + extra delay_S)/2
- With this calculation the times of TSref are generated at the same time for the P channel and S channel (see Figure 82).

After the ring recovery in CP3 and CP4:

- The master shall measure at least 64 times the physical delays of the P channel (primary) and / or S channel (secondary) and determines the average (tRing) of all measurements. The measured tRing can be checked using the following formula:

  tRing = (tRing_P + tRing_S)/2
- The master shall determine the IFG jitter dependent of the participants in the topology.
- The master shall add an extra delay taking into account one of the following formulas.
  - (IFG jitter + extra delay)/2 = tRing_P+(IFGjitter_P+extra delay_P)/2- tRing
  - (IFG jitter + extra delay)/2 = tRing_S+(IFGjitter_S+extra delay_S)/2- tRing
- The Master calculates the ring delay for the given ring to keep the TSref time synchronous to the previous P channel and S channel. The time TSref shall be constant during ring recovery.
- The master shall transmit the S-0-1015 Ring delay to all synchronizing slaves. After that, the master shall activate the S-0-1024 SYNC delay measuring procedure command to announce the slave, that it shall synchronize on both ports.

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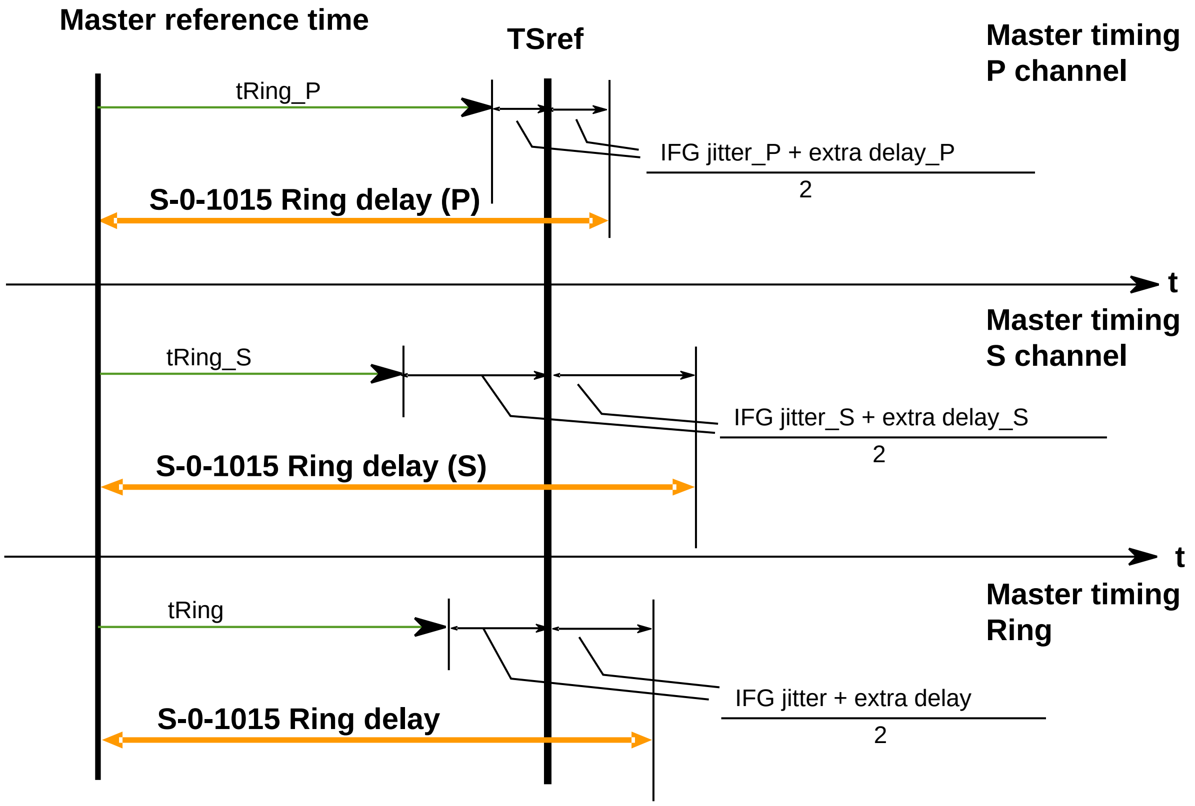

Figure 82 – Timing of TSref with interrupted ring

7.2.1.3 Acquisition of synchronization reference time in the slave

With the activation of the S-0-1024 SYNC delay measuring procedure command the slave starts the ring delay acquisition procedure.

As shown in Figure 83, each slave shall be fitted with the following features:

- S-0-1016 Slave delay (P&S) contains two SYNC counter (SYNCCNT-P/S) one for each port, whereas each of them shall start counting from zero, if a MST is received on the corresponding port.
- An adder, which continuously builds the sum of both SYNC counter values.
- A comparator, which continuously compares the adder state value (sum of both SYNC counter values) with the value of the parameter S-0-1015 Ring delay.
- The sum related comparator signalizes that the sum of both SYNC counter values has reached a value greater or equal to the ring delay value. In this case both SYNC counter are stored in the parameter S-0-1016 Slave delay (P&S).
- The slave acknowledges the S-0-1024 SYNC delay measuring procedure command positively.
- Each slave determines 2 SYNC counter values dependent on the physical order in the topology (SYNCCNT-P + SYNCCNT-S = S-0-1015 Ring delay).
- The master cancels the S-0-1024 SYNC delay measuring procedure command.
- With ring topology:
  - these 2 SYNC counters are used for the synchronization in the slave.
  - the slave shall synchronize on both ports

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- With line topology:
  - the SYNCCNT with the lower value is set to 0 by the slave and is not used for the synchronization.
  - the slave shall synchronize on one port only.

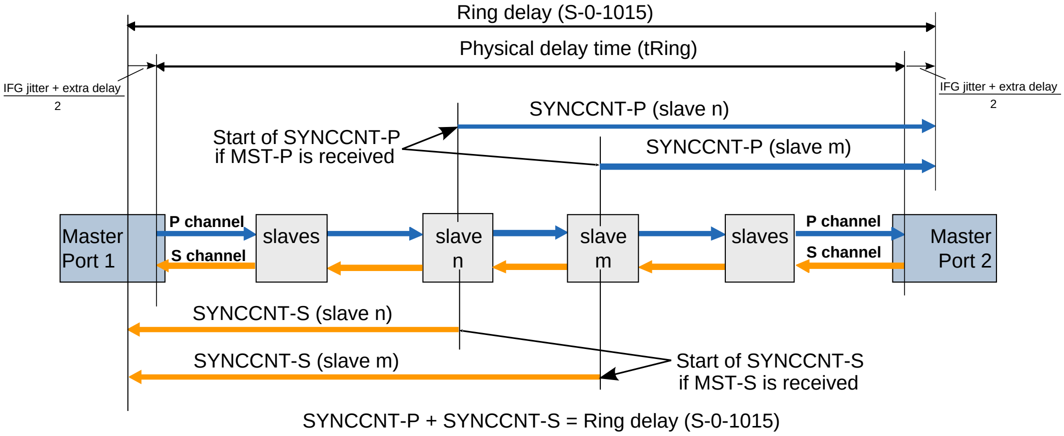

Figure 83 – Determination of the SYNC delay time

7.2.1.4 Synchronization with ring topology

As shown in Figure 76 and in Figure 80, each slave shall generate a synchronization trigger once per communication cycle. The slave shall evaluate only the MST on port 1 and port 2 for synchronization. The SIII header within MDT1 to MDT3 and AT0 to AT3 shall not be used for synchronization.

As shown in Figure 84, each slave shall generate its synchronization reference time (TSref) as soon as any one of the following conditions is met:

- The MST-P (primary channel) has been received at one port, the slave has activated the synchronization delay time (SYNCCNT-P) and this delay has been expired, or
- the MST-S (secondary channel) has been received at the other port, the slave has activated the synchronization delay time (SYNCCNT-S), and this delay has been expired.

The slave shall generate one synchronization reference time (TSref) only within one communication cycle, as soon as the first of these conditions is met. The slave may ignore the second synchronization trigger which occurs later in the communication cycle.

7.2.1.5 Synchronization with line topology

For synchronization purpose the slave shall evaluate the MST on one port (port 1 or port 2) only. The SIII header within MDT1 to MDT3 and AT0 to AT3 shall not be used for synchronization.

The slave shall use the port (port 1 or port 2) on which it receives first the MST (this port is closer to the master) and generates the synchronization trigger. The port with the later received MST shall not be used for the synchronization trigger.

As shown in Figure 84, each slave shall generate its synchronization reference time (TSref) as soon as the earlier MST (P or S) has been received at one port, the slave has activated the corresponding synchronization delay time (SYNCCNT-P or S) and this delay has been expired.

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The slave shall generate one synchronization reference time (TSref) only within one communication cycle. The slave shall ignore the second synchronization trigger which occurs later in the communication cycle.

7.2.1.6 Slave behavior by missing synchronization signals

If a slave doesn't receive a MST on port 1 nor on port 2 within one communication cycle, then the slave shall

- generate an internal synchronization trigger during this communication cycle.
- increment the internal MST error counter once per communication cycle.

If a slave generates an internal synchronization trigger because of missing MSTs during several successive communication cycles, then the slave shall behave as specified in S-0-1003 Allowed MST losses in CP3&CP4.

7.2.1.7 Definitions of Synchronization reference time and S-0-1007 Synchronization time (Tsync)

Each slave receives two MSTs in line or ring topology and gets two synchronization triggers. But the slave selects only the first received synchronization trigger to generate the synchronization reference time (TSref) (see Figure 84). If the application needs a better performance of the synchronization timing, then the synchronization reference time (TSref) can be smoothed by a digital phase-locked loop (DPLL).

The synchronization reference time (TSref) is based on communication and is identical in all synchronized slaves in a given network. But a network can have several synchronization groups with different S-0-1007 Synchronization time (Tsync) depending of the application. All synchronized slave within one synchronization group shall have the same S-0-1007 Synchronization time (Tsync).

With S-0-1007 Synchronization time (Tsync) the master can optimally adjust the processing cycles of the application in the control unit and in the slaves to the telegram timing of the communication cycle. Therefore, the processing cycles of the application are decoupled from communication cycle, and the dead time can be minimized in a closed-loop control circuit which contains the communication.

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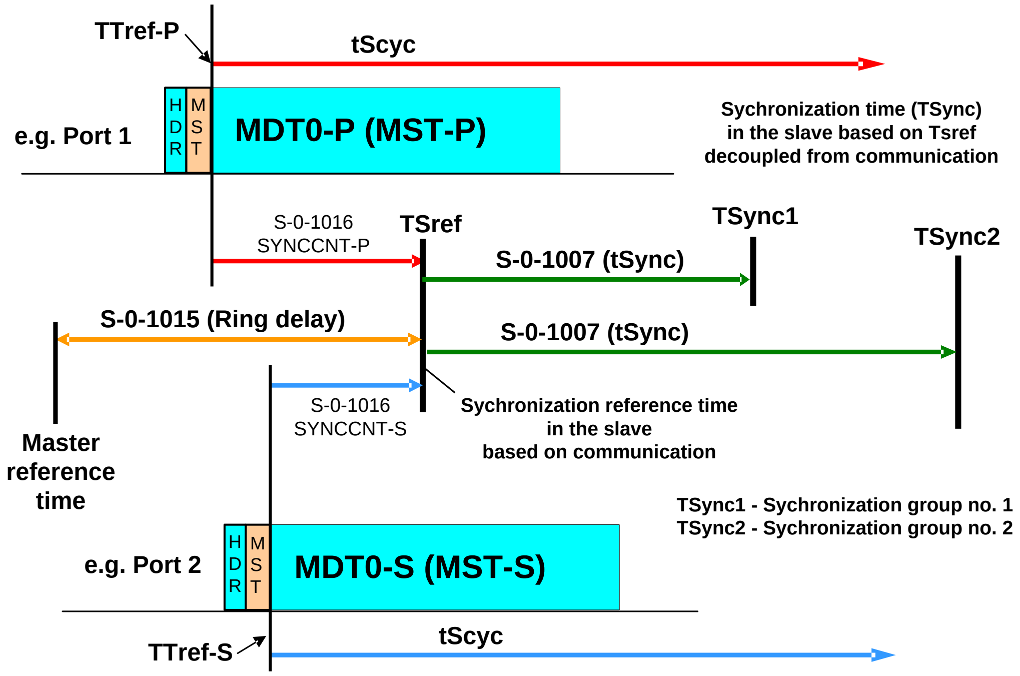

Figure 84 – Definition of TSref

7.2.2 Synchronization of producer cycles

7.2.2.1 General

Type 19 slave or master devices are able to be producer of connections. Each connection has its own S-0-1050.x.10 Producer Cycle Time (tPcyc), which can be the communication cycle time (tScyc S-0-1002) or a multiple of it. If there was no synchronization, each producer would produce application data independently.

Type 19 networks offers a possibility to synchronize these connections. This means all synchronized connections provide application data cyclically at a common time. The base for this time is the Type 19 header of MDT0 (MST). Having received the synchronization MST all connections prepare to capture application data. The connections need to wait for a period of time, called the Feedback acquisition capture point (S-0-1007 Synchronization time (Tsync)) until they capture the real time data. Connections that shall be synchronized need to be configured with the same T4pc value. If several connections synchronize at the same T4pc, this T4pc is also called TSync.

For being able to have different producer cycle times in connections that shall be synchronized, TSync doesn't necessarily appear within each communication cycle. This means that not every MST needs to be a synchronization MST (see Figure 85).

- MaximumScycCnt = (LCM(tPcyc1,tPcyc2,tPcyc3,...) / tScyc) − 1

The period between two TSyncs is called the synchronization cycle time (tSync-cycle). This tSync-cycle needs to be determined in regard to the used producer cycle times. The least common multiple (LCM) of all used producer cycle times are used to define tSync-cycle. The calculation looks as follows:

The tSync-cycle is (Maximum ScycCnt +1) * tScyc.

In order to have a better understanding for TSync and tSync-cycle, two cases with different tPcyc values are considered in 7.2.2.2 and 7.2.2.3:

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7.2.2.2 Producer cycle time are integer multiple of communication cycle time

In this example each producer has different producer cycle times. There are two connections with producer cycle times defined as follows:

- tPcyc1 = 2x tScyc
- tPcyc2 = 3x tScyc

The tSync-cycle is calculated as follows:

- tSync − cycle = LCM(tPcyc1,tPcyc2) = 6 * tScyc

The MST is used as synchronization base. In the producer cycle after TSync both producers produce application data synchronously. The second MST received within tSync-cycle is not used for synchronization purposes. Having produced application data synchronously, each producer continues producing application data in frequency of its producer cycle time. The next synchronization takes place after tSync-cycle.

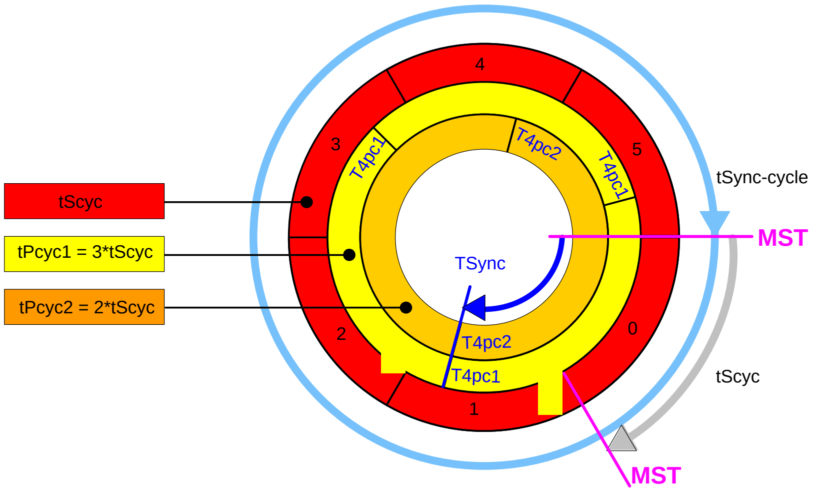

Figure 85 – Timing with different cycle times

7.2.2.3 Producer cycle time is equal to communication cycle time

In this example there are two producers with the same producer cycle time (tScyc = tPcyc1 = tPcyc2). In this case each MST is used for synchronization purposes (see Figure 86). The tSync-cycle is calculated as follows:

- tSync − cycle = LCM(tPcyc1,tPcyc2) = 1 * tScyc

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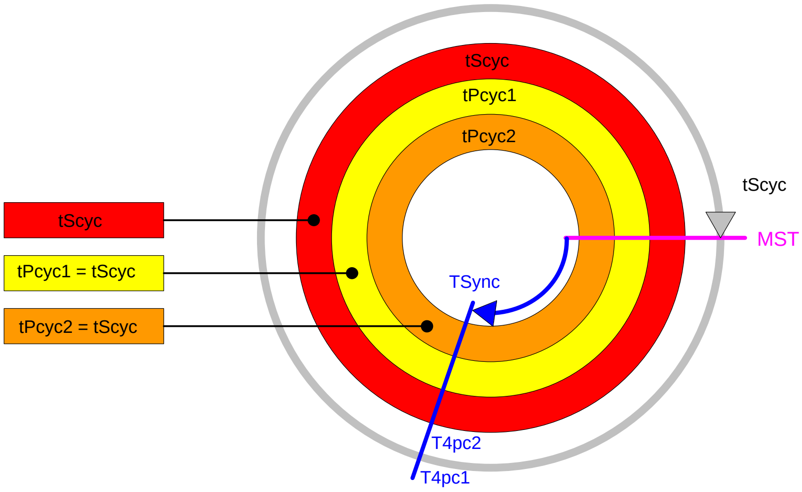

Figure 86 – Timing with the same cycle times

7.3 Processing methods of connection data

7.3.1 General

Three methods of connection processing are specified for Type 19 networks. These are

- Synchronous processing of application data
- Cyclic processing of application data
- Non-synchronous processing of application data

7.3.2 Synchronous processing of application data in the slave

The timing of the synchronous processing is related to the S-0-1007 Synchronization time (Tsync) and at every T4pc defined by the S-0-1050.x.10 Producer Cycle Time. The timing of the telegram processing is related to the end of MST (TTref). The delay of the telegram timing and synchronous timing is defined in S-0-1016 Slave delay (P&S). The timing delay (Time-del) is the difference of SYNCCNT-P and SYNCCNT-S (Time_del = SYNCCNT-P - SYNCCNT-S). The timing of synchronous processing of application data is shown in Figure 87.

- Synchronous processing of application data in the producer: The application data shall be produced in every producer cycle (tPcyc). The processing time of the producer data (tmp-P) are specified in S-0-1060.x.07 Maximum processing time resp. S-0-1005 Minimum feedback processing time (t5). The processing time (tmp-P) shall start at time T4pc resp. TSync.
  Depending on the functionality, the slave shall either use the S-0-1005 Maximum Producer processing Time (t5) for all connections or the S-0-1060.x.07 Maximum processing time for each connection separately.
  - Case 1 of producing application data: If the difference between t1 and T4pc is greater than or equal to the processing time (tmp-P), taking into account the timing delay (Time_del), then the application data are transmitted in the AT in the same communication cycle. tmp-P or t5 ≤ t1 - Time_del - T4pc.
  - Case 2 of producer data: If the processing time (tmp-P) takes longer than the time t1, then the application data are transmitted in the AT of the next communication cycle. tmp-P or t5 > t1 - Time_del - T4pc.
- Synchronous processing of application data in the consumer: The application data shall be consumed in every producer cycle (tPcyc). The processing time of the consuming (tmp-C) are specified in S-0-1060.x.07 Maximum processing time resp. S-0-1047 Maximum Consumer Activation Time (t11). The processing time (tmp-C) should end before the time T4pc resp. TSync. The end of MDT block is determined in the telegram timing calculation.

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– Case 1 of consuming application data: If the difference between End of MDT block and T4pc is greater than or equal to the processing time (tmp-C), taking into account the timing delay (Time_del), then the received application data are activated at time T4pc of the same producer cycle. tmp-C or t11 ≤ T4pc + Time_del - End of MDT block.

– Case 2 of consuming application data: If the processing time (tmp-C) takes longer than the time T4pc, then the received application data are activated at time T4pc of the next producer cycle. tmp-C or t11 > T4pc + Time_del - End of MDT block.

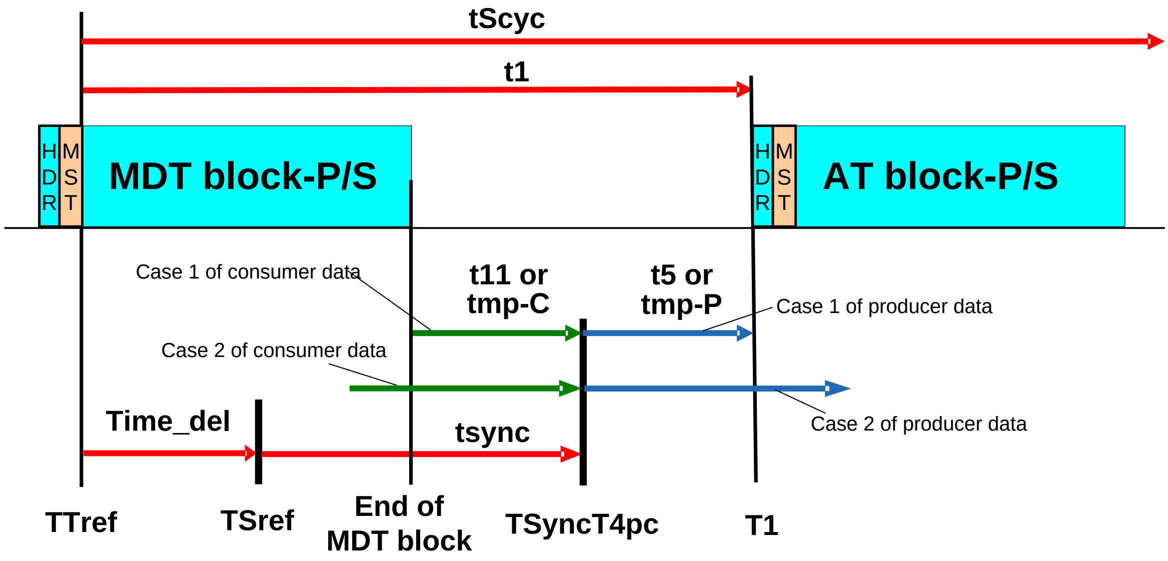

Figure 87 – Synchronous application data processing

7.3.3 Cyclic processing of application data in the slave

The cyclic processing is based to the beginning and ending of the corresponding telegram and shall be activated in every S-0-1050.x.10 Producer Cycle Time. The beginning and end of the Type 19 telegram is determined in the telegram timing calculation. The timing of the telegram processing is related to the end of MST (TTref). The delay between the P telegram and S telegram is defined in S-0-1016 Slave delay (P&S). The timing delay (Time-del) is the difference of SYNCCNT-P and SYNCCNT-S (Time_del = SYNCCNT-P - SYNCCNT-S). The timing of cyclic processing of application data is shown in Figure 88.

- Cyclic processing of application data in the producer: The application data shall be produced in every producer cycle (tPcyc). The processing time of the producing (tmp-P) are specified in S-0-1060.x.07 Maximum processing time resp. S-0-1005 Minimum feedback processing time (t5).
  – Case 1 of producing application data: If the processing time (tmp-P or t5) is finished before the Type 19 telegram is started, then the application data are transmitted in this Type 19 telegram of this communication cycle.
  – Case 2 of producing application data: If the processing time (tmp-P or t5) is not finished before the Type 19 telegram is started, then the application data are transmitted in the Type 19 telegram of the next communication cycle.
- Cyclic processing of application data in the consumer: The application data shall be consumed in every producer cycle (tPcyc). The processing time of the consuming (tmp-C) are specified in S-0-1060.x.07 Maximum processing time resp. S-0-1047 Maximum Consumer Activation Time (t11).
  – Case 1 of consuming application data: If the processing time (tmp-C or t11) starts after the end of the Type 19 telegram, then the received application data in this Type 19 telegram are activated in the same producer cycle.

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– Case 2 of consuming application data: If the processing time (tmp-C ot t11) starts before the end of the Type 19 telegram, then the received application data in this Type 19 telegram are activated in the next producer cycle, that means the application data of a previous producer cycle are activated in a later producer cycle.

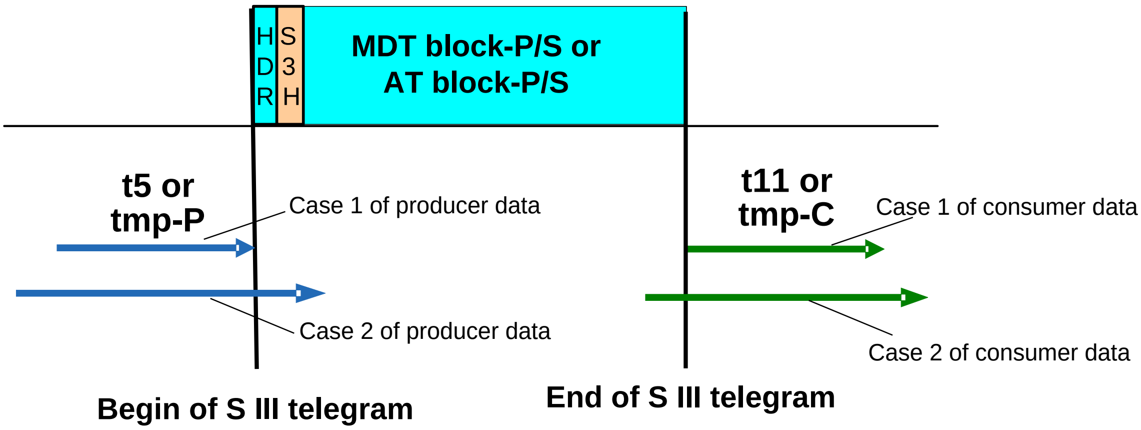

Figure 88 – Cyclic application data processing

7.3.4 Non-synchronous processing of application data in the slave

The non-synchronous processing does not use any timing parameters. The beginning and end of the Type 19 telegram is not defined by parameters. The delay between the P telegram and S telegram is not defined. The diagram of non-synchronous processing of application data is shown in Figure 89.

Non-synchronous processing of application data in the producer: The application data can be produced to any time, that means a producer cycle time is not defined. The producing of the application data is random and the start of the processing time and the processing time itself is not defined also.

Non-synchronous processing of application data in the consumer: The application data can be consumed at any time, that means a producer cycle time is not defined. The consuming of the application data is random and the processing time of the application data is not defined also. It makes sense to start the consuming of the application data only, if the corresponding Type 19 telegram was received.

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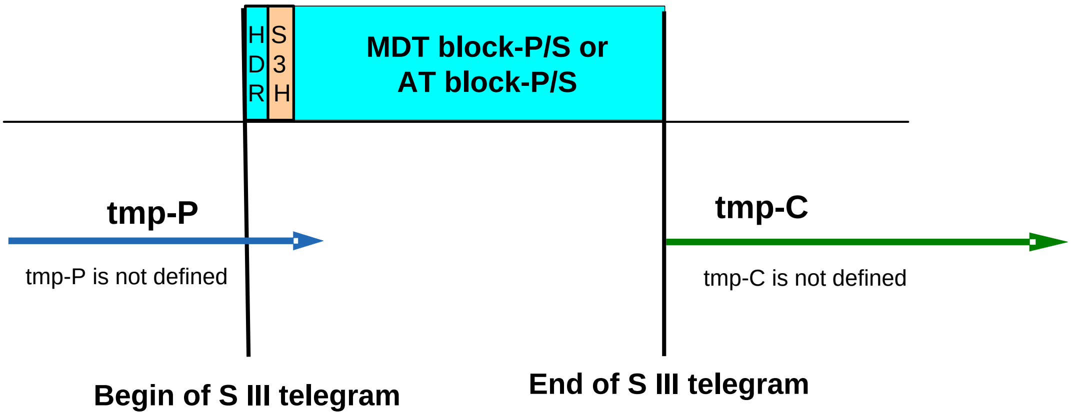

Figure 89 – Non-synchronous application data processing

8 Communication Error handling and monitoring

8.1 Invalid telegrams

The contents of invalid MAC telegrams shall not be passed to sublayers. The occurrence of invalid MAC telegrams may be communicated to network management. Invalid MAC telegrams may be ignored or discarded.

An invalid telegram shall be defined as one that meets at least one of the following conditions:

- Alignment error: It is not an integral number of octets in length.
- FCS error: The bits of the incoming telegram (exclusive of the FCS field itself) do not generate a FCS value identical to the one received.
- CRC error: The bits of the incoming telegram (exclusive of the CRC field itself of Type 19 header) do not generate a CRC value identical to the one received.
- Type 19 telegram length error: The telegram was not received with the expected length.
- Type 19 telegram loss: The telegram was not received in the expected time slot (for example MST not received within MST window).

8.2 Response to MDT and AT telegram failure

If a telegram failure occurs, the master and the slave shall respond as follows:

- the synchronization of the interface shall be maintained;
- several counters (internal) shall be incremented for missing telegrams.

The application profile may specify additional response (for example on the basis of the last correct command values, a power drive system shall calculate internal command values to replace the data of the missing telegram, as specified in FSP_Drive).

The parameter S-0-1003 (Allowed MST losses in CP3&CP4) defines the maximum number of communication cycles in which a slave may not receive its MST in CP3 and CP4. The slave shall switch from CP3 and CP4 back to NRT state if it did not receive its MSTs within more than the user-defined quantity in S-0-1003 and shall set

- the error C1D in the device status and
- the S-0-0390 Diagnostic number to 0xC30F4001.

After half the amount of cycles specified in S-0-1003, the slave shall set

- the communication warning bit in its device status (bit 15) and

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- the S-0-0390 Diagnostic number to 0xC30E4001.

8.3 Error counters in the slave

In order to make available the amount of errors recognized in the slaves two IDN are defined and shall be implemented in the slaves:

- S-0-1028 Error counter MST-P&S: This IDN shall be used to show the total amount of MST (MDT0) losses occurred.
- S-0-1035 Error counter Port1 and Port2: This IDN shall be used to show the total amount of telegram losses (Type 19 telegrams and “non-Type 19” telegrams) occurred.

8.3.1 Error effects on communication phases

8.3.1.1 Ascending communication phases

The sequence of communication phases shall be maintained in ascending order (0, 1-4). If this sequence is not maintained, the slave shall return to NRT state.

The slave shall set

- the error C1D in the device status and
- the S-0-0390 Diagnostic number to 0xC30F4004.

8.3.1.2 Descending communication phases

A change of the CPs in descending order shall only be accomplished through CP0. The switching of communication phases from CP0 to CP4 shall be accomplished in accordance with 5.2.

If the master switches from a higher CP to a lower CP other than CP0, the slave shall then immediately return to NRT state and wait for the MDT0 of CP0 from the master.

The slave shall set

- the error C1D in the device status and
- the S-0-0390 Diagnostic number to 0xC30F4005.

8.4 Status codes of Type 19 communication profile (SCP)

This article defines the status codes for the Type 19 communication profile (SCP), which are used for the language-neutral presentation of diagnostic information of Type 19 slave devices. The defined diagnosis classes and status codes of the SCP are listed in Table 111 and Table 112.

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Table 111 – SCP specific status codes

Bit 31 – 20 Interpret. & Source (hex)	Bit 19-16 Class (hex)	Bit 15-0 Status code (hex)	Description
C30	A	0000	Communication phase 0
C30	A	0001	Communication phase 1
C30	A	0002	Communication phase 2
C30	A	0003	Communication phase 3
C30	A	0004	this status code shall not be used
C30	A	0005	this status code shall not be used
C30	A	0006	this status code shall not be used
C30	A	0007	this status code shall not be used
C30	A	0008	NRT state
C30	A	0009	this status code shall not be used
C30	A	0030	Hot-plug phase 0 (HP0)
C30	A	0031	Hot-plug phase 1 (HP1)
C30	A	0032	Hot-plug phase 2 (HP2)
C30	C	0100	S-0-0127 CP3 transition check (Transition from CP2 to CP3)
C30	C	0101	Invalid parameters (Data block elements required in CP3 are missing or invalid)
C30	C	0104	Configured IDN for MDT not configurable
C30	C	0105	Maximum length for MDT exceeded
C30	C	0106	Configured IDNs for AT not configurable
C30	C	0107	Maximum length for AT exceeded
C30	C	0108	Timing parameter > Type 19 cycle time (tScyc) - t1, t6, t7, etc.
C30	C	0109	Telegram offset unsuitable (e.g. telegram offset outside of telegram, etc.)
C30	C	0110	this status code shall not be used
C30	C	0111	this status code shall not be used
C30	C	0112	this status code shall not be used
C30	C	0113	this status code shall not be used
C30	C	0114	this status code shall not be used
C30	C	0115	this status code shall not be used
C30	C	0116	this status code shall not be used
C30	C	0139	this status code shall not be used
C30	C	0170	Configured IDNs for connection not configurable
C30	C	0171	Maximum length for connections exceeded
C30	C	0172	S-0-1024 SYNC delay measuring procedure command not performed (The master didn't activate this procedure command)
C30	C	0173	Quantity of connections is not configurable
C30	C	0174	Connection configuration is not possible
C30	C	0175	Producer cycle time (tPcyc) of a connection is wrong
C30	C	0176	SCP classes not correct configured (Configured SCP Classes or its combination in S-0-1000.0.1 List of Active SCP Classes & Version is not supported by the slave)
C30	C	5200	S-0-0128 CP4 transition check (Transition from CP3 to CP4)

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Bit 31 – 20 Interpret. & Source (hex)	Bit 19-16 Class (hex)	Bit 15-0 Status code (hex)	Description
C30	C	5300	S-0-1024 SYNC delay measuring procedure command
C30	C	5301	S-0-1024 SYNC delay measuring procedure command failed (S-0-1015 Ring delay = 0)
C30	C	5302	S-0-1024 SYNC delay measuring procedure command error (Measuring is interrupted or disturbed or S-0-1015 Ring delay is too small)
C30	C	0	reserved
C30	E	4001	Warning of MST losses (Amount of MST losses are half of S-0-1003 in CP3 & CP4)
C30	E	4002	RTD-failure shutdown
C30	E	4003	invalid communication phase recognized
C30	E	4004	sequence of CP during phase upshift is not correct
C30	E	4005	sequence of CP during phase downshift is not correct
C30	E	4006	The master changes the current-CP with MST.Phase.CPS = 0,
C30	E	4007	Consumer connection failed
C30	E	4008	Invalid addressing of MDT data container A
C30	E	4009	Invalid addressing of AT data container A
C30	E	4010	reserved
C30	E	4019	CPS=1 and master changes the CP to an invalid value (see 5.2.3.4)
C30	E	4020	Topology status changes from fast-forward (FF) to loop-back with forward (L&F) - removed when changing from L&F to FF (occurs when changing from FF to L&F, removed when changing from L&F to FF)
C30	E	0	reserved
C30	F	4001	Error of MST losses (Amount of MST losses in CP3 & CP4 exceeded. The slave switches to NRT mode. see 5.2.3.4)
C30	F	4002	connection losses (Amount of data losses > S-0-1050.x.11 in CP4. see 4.7)
C30	F	4003	reserved for Type 16
C30	F	4004	reserved for Type 16
C30	F	4005	reserved for Type 16
C30	F	4006	reserved (this status code shall not be used)
C30	F	4017	CPS-MST timeout (500 ms) occurs during phase switch (see 5.2.3.4)
C30	F	4018	OVS producer data are invalid
C30	F	4019	CPS=0 and master changes the CP to an invalid value (see 5.2.3.4)
C30	F	4020	Topology status changes from Loop-back with Forward to NRT mode (occurs if cable is broken on active port)
C30	F	4021	Slave doesn't support the announced Communication Version for CP1 and CP2
C30	F	4022	reserved
C30	F	4023	reserved
C30	F	0	reserved

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8.5 Priority of diagnosis classes

Type 19 defines the following diagnosis classes, which are used to categorize diagnostic information according to their context and impact on the error status of the device and its components.

Each diagnosis class has a specific priority, which is used for the prioritization purpose.

In general, the assignment of diagnosis classes to particular diagnostic information is manufacturer-specific.

Table 112 – Overview on diagnosis classes

Diagnosis class	Priority	Description
Operational state	4 (lowest)	Diagnostic information, representing an event or state, which implicates no threat to the device or component, for example “Torque control“ or “compatible replacement of IO module”.
Procedure command specific state	3	Diagnostic information, which is generated during the execution of a procedure command and clearly can be assigned to this command, for example “S-0-0420 Activate parametrization level procedure command (PL) executed” or “reference mark not detected”
Warning (C2D)	2	Diagnostic information, representing an event or state, which implicates a threat to the device or component, for example “motor over-temperature warning” or “under voltage of certain device components”.
Error (C1D)	1 (highest)	Diagnostic information, representing an event or state, which implicates a failure of the system, “loss of motor encoder reference” or “malfunction of the local bus”.
Operational state	4 (lowest)	Diagnostic information, representing an event or state, which implicates no threat to the device or component, for example “Torque control“ or “compatible replacement of IO module”.

But in the following cases, Type 19 dictates the diagnosis classes, which have to be assigned to diagnostic information:

- If diagnostic information is specific to a procedures command, it has to be assigned to the diagnosis class “procedure command specific state”.
- If diagnostic information in general has an impact on the error status of a component, Type 19 assigns the diagnostic information fix to the corresponding diagnosis class by means of the description of the status codes.

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Annex A
(normative)

IDN – Identification numbers

A.1 IDN specification

A.1.1 Introduction

All parameters shall be assigned to IDNs.

Every parameter consists of elements. Elements are used to supply additional information, which is required to allow the display and input of data and the use of universal routines by means of the control terminal. This additional information is necessary for handling arbitrary slave-related data. With this information, anonymous parameter can be interpreted by the user interface. The parameter structure shall be as shown in Table A.1. In a parameter, elements 1, 3, and 7 are mandatory and shall always be present. Elements 2, 4, 5, and 6 are optional and may be supported depending on configuration. Elements 5 and 6 are mandatory for cycle time parameters only. The appropriate elements of the parameters shall be selected via the service channel control bits.

Scope of parameter (global / local)

This aspect of the scope of a parameter is only relevant if a device consists of multiple sub-devices. There are two different scopes of parameters, global and local.

- Global parameters are unique within one device. Changes on a global parameter in one sub-device, causes changes in all other sub-devices in the device. For example, the IP-address is unique in one device. Global parameter shall exist in every sub-device.
- Local parameters are unique in one sub-device. Local parameter may exist only in one sub-device.

Table A.1 – Data block structure

Element No.	Description	Requirement
1	IDN	mandatory
2	Name	optional
3	Attribute	mandatory
4	Unit	optional
5	Minimum value	optional
6	Maximum value	optional
7	Operation data	mandatory
NOTE Elements 5 and 6 are mandatory for cycle time parameters (S-0-1050.x.10, S-0-1002).		

A.1.2 Element 1: structure of IDN

If written and read via the service channels, the appropriate data shall be addressed by means of the IDNs. Beyond that, operation data within the configurable part of the data records of the AT and MDT shall be as defined by means of the IDNs.

IDN numbering shall have a range of 2^{32}, which shall be subdivided as follow:

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- Two ranges shall be available for standard IDNs and product-specific IDNs. Product-specific IDNs are out of the scope of standardization.
- Every range shall be subdivided into eight parameter sets.
- Each set shall thus have up to 4 095 data block numbers or function groups.
- Each IDN may have up to 256 structure instances and up to 256 structure elements.

IDNs shall be transferred in telegrams as 32-bit binary numbers.

Table A.2 describes the structure of IDNs.

Table A.2 – Parameter structure

Bit Number	Value	Description
31-24	—	Structure instance (SI)
	0-255	Number of structure instance (SI)
23-16	—	Structure element (SE)
	0-127 (bit 23 = 0)	Standard SE (bit 15 = 0) determined by Type 19 (bit 15 = 0)
	128-255 (bit 23 = 1)	Product specific SE determined by manufacturer (bit 15 = 0)
15	—	Standard or product specific data (S or P)
	0	Standard IDN (S-0-nnnn), SE (0-127), SI and data block number determined by Type 19
	1	Product-specific IDN (P-0-nnnn), Bits 31 to 0 determined by manufacturer
14-12	—	Parameter sets
	0-7	Parameter set 0 – 7 (Type 19 specifies IDNs with parameter set 0 only.)
11-0	—	Data block or Function group
	0-4095	Data block number (if SI = SE = 0); Function group (if SI or SE is not 0)

The notation of an IDN shall be as follows:

- If no SI or SE exists, it shall be: S/P - Parameter Set - Data block number (for example S-0-1002)
- If SI and SE exist, it shall be: S/P - Parameter Set - Function group . SI . SE (for example S-0-1300.0.2)

A.1.3 Element 2: structure of name

The name shall have two length specifications of two octets each and a character string of maximum 60 UTF8 characters (up to 240 octets). Octets 1 and 2 of the name shall specify the current text length in octets. Octets 3 and 4 of the name shall indicate the maximum text length in octets in a slave.

Figure A.1 shows the IDN name structure.

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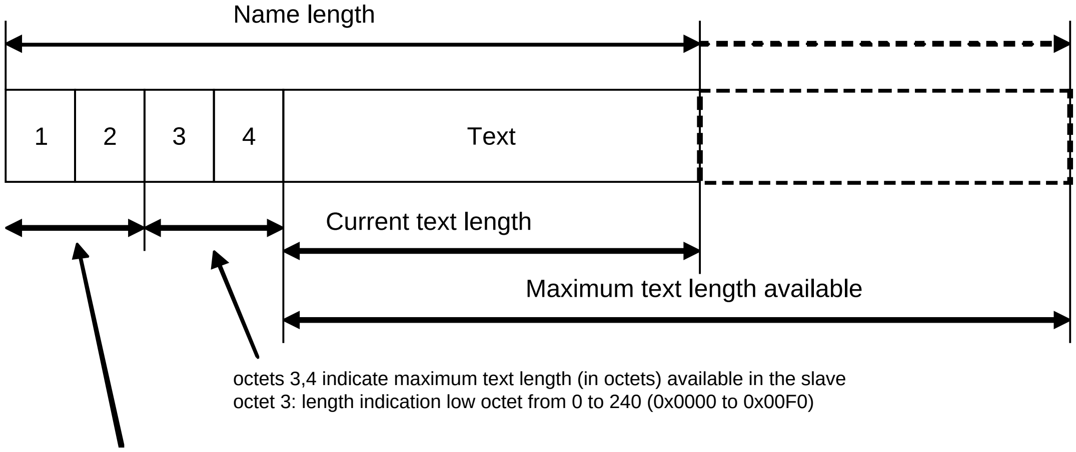

Figure A.1 – IDN name structure

If the current text has a length of 0, only the two length indications shall be transmitted. Octets 1 and 2 shall then contain the value 0.

Reading: In order to complete a read command in the service channel, the master shall require octets 1 and 2. Octets 3 and 4 shall only be read by the master to prevent writing text which is too long.

Writing: When writing a name, the master shall set octets 1 and 2 according to the current text length. The text shall not be longer than specified in octets 3 and 4. During writing the slave shall ignore octets 3 and 4 and insert its available length during reading.

A.1.4 Element 3: structure of attribute

Every parameter shall have an attribute which allows for an intelligible representation of various operation data by means of universal routines. The attribute shall contain all information which is needed to display operation data intelligibly. The attribute makes it possible to convert the transferred operation data into intelligible display data and vice versa. The conversion shall have no impact on the data itself. If data needs to be scaled, specific scaling parameters shall be supplied. Every scaling modification needs a change in the attributes of the affected data. It is recommended to write protect the attribute. See Table A.3.

Table A.3 – Element 3 of IDNs

Bit no,	Value	Description
31	—	(reserved)
30	—	Write protected in CP4
	0	Operation data is writeable
	1	Operation data is write protected
29	—	Write protected in CP3
	0	Operation data is writeable
	1	Operation data is write protected
28	—	Write protected in CP2
	0	Operation data is writeable
	1	Operation data is write protected
27-24	—	Decimal point: This is an additional display information.

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Bit no,	Value	Description
		Places after the decimal point indicate the position of the decimal point for the display and input of appropriate operation data. Decimal point is used for displaying of signed and unsigned decimal. For all other display formats the decimal point shall be = 0
	0000 to 1111	No place to 15 places after decimal point (maximum)
23	—	(reserved)
22-20	—	Data type and display format. Data type and display format are used to convert the operation data and the minimum and maximum input value to the correct display format
	000	Data type: Binary number Display format: Binary
	001	Data type: Unsigned integer Display format: Unsigned decimal
	010	Data type: Integer Display format: Signed decimal
	011	Data type: Unsigned integer Display format: Hexadecimal
	100	Data type: Extended character set Display format: Text (ASCII)
	101	Data type: Unsigned integer Display format: IDN
	110	Data type: Floating-point number Display format: Signed decimal with exponent (float) Single or double precision, according to ANSI/IEEE 752-1995
	111	Data type: Type 19 time Display format: according to IEC 61588 4 octets seconds & 4 octets nano seconds, starts with 1.1.1970 computed in UTC
19	—	Parameter is:
	0	Not a procedure command
	1	a procedure command
18-16	—	Data length: Data length is required so that the master is able to complete service channel data transfers correctly
	000	(reserved)
	001	Operation data is two octets long
	010	Operation data is four octets long
	011	Operation data is eight octets long
	100	Variable length with one-octet data strings
	101	Variable length with two-octet data strings
	110	Variable length with four-octet data strings
	111	Variable length with eight-octet data strings
15-0	—	Conversion factor: the conversion factor is an unsigned integer used to convert numeric data to display format. The conversion factor shall be set to a value of 1 when it is not needed for data display (for example: for binary number, character string or floating-point number etc.)

The display formats and data length shall have any of the valid combinations (“yes” marked) in Table A.4.

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Table A.4 – Valid combinations of the display formats

Data length	Binary	Unsigned decimal	Signed decimal	Hex	Text	IDN	Float	Time
2 octet	yes	yes	yes	yes				
4 octet	yes	yes	yes	yes		Yes	yes	
8 octet	yes	yes	yes	yes			yes	yes
1 octet list	yes	yes	yes	yes	yes			
2 octet list	yes	yes	yes	yes				
4 octet list	yes	yes	yes	yes		yes	yes	
8 octet list	yes	yes	yes	yes			yes	yes

A.1.5 Element 4: structure of unit

The unit shall have two length specifications of two octets each and a character string of maximum 12 UTF8 characters (up to 48 octets). Octets 1 and 2 of the unit shall specify the current text length in octets. Octets 3 and 4 of the unit shall indicate the maximum text length in octets in a slave. A parameter shall not have any unit if the data type is either a binary number or a character string. see Figure A.2.

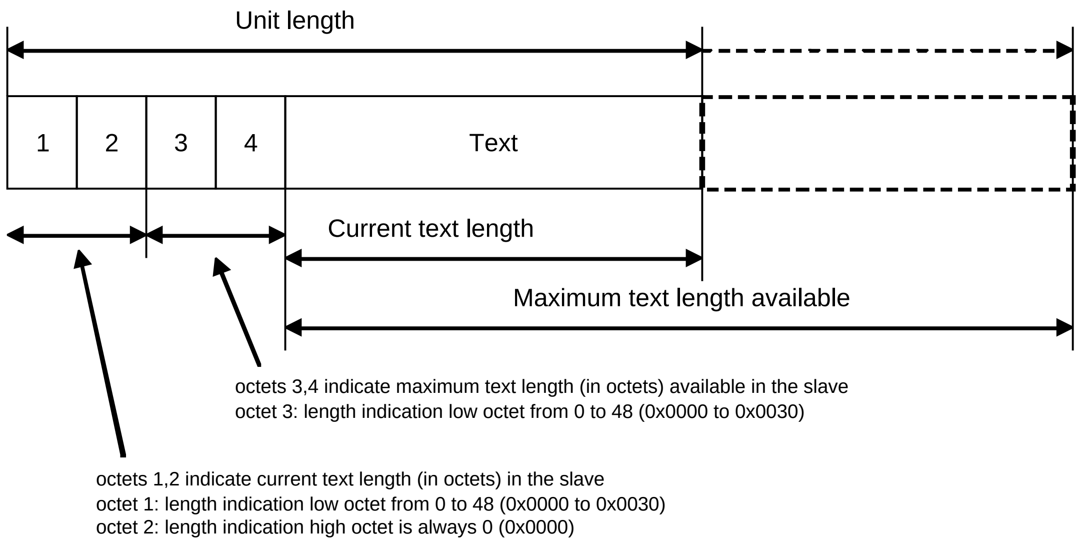

Figure A.2 – Unit structure

If the current text has the length 0, only the two length indications shall be transmitted. Octets 1 and 2 shall then contain the value 0.

Reading: In order to complete a read command in the service channel, octets 1 and 2 shall be required by the master. Octets 3 and 4 shall only be read by the master to prevent writing text which is too long.

Writing: When writing a unit, the master shall set octets 1 and 2 according to the current text length. The text shall not be longer than specified in octets 3 and 4. During writing the slave shall ignore octets 3 and 4 and insert its available length during reading.

A.1.6 Element 5: structure of minimum value

The minimum input value shall be the smallest numerical value for the operation data which the slave is able to process and have the same length as operation data.

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If the slave ignores the write request of the operation data, only in this case the slave shall return the corresponding error code and set the SVC error bit in the SVC status.

The following data types do not have minimum input value:

- binary number
- character string
- IDN.

The minimum input value shall be displayed like the operation data.

It is recommended to write protect the minimum input value.

A.1.7 Element 6: structure of maximum value

The maximum input value shall be the largest numerical value for the operation data which the slave is able to process and has the same length as operation data.

If the slave ignores the write request of the operation data, only in this case the slave shall return the corresponding error code and set the SVC error bit in the SVC status.

If the operation data is a binary number, then the supported bits are set in the maximum input value. The master therefore recognizes which bits are supported by the slave in this parameter.

The following data types do not have maximum input value:

- character string and
- IDN.

The maximum input value shall be displayed like the operation data.

It is recommended to write protect the maximum input value.

A.1.8 Element 7: structure of operation data

When the operation data of an IDN is written, which is a bit field, the slave shall mask the written operation data by using the mask of supported bits (which the slave may show by the maximum value of the IDN) and then process the written data.

The operation data shall have any one of following lengths:

- fixed length with two octets;
- fixed length with four octets;
- fixed length with eight octets;
- variable length with list elements of 1, 2, 4 and 8 octets up to 65 532 octets.

Variable length

Length specifications for the variable length only shall be coded in the initial four octets for hexadecimal digits. Structure of operation data with variable length shall be as shown in Figure A.3.

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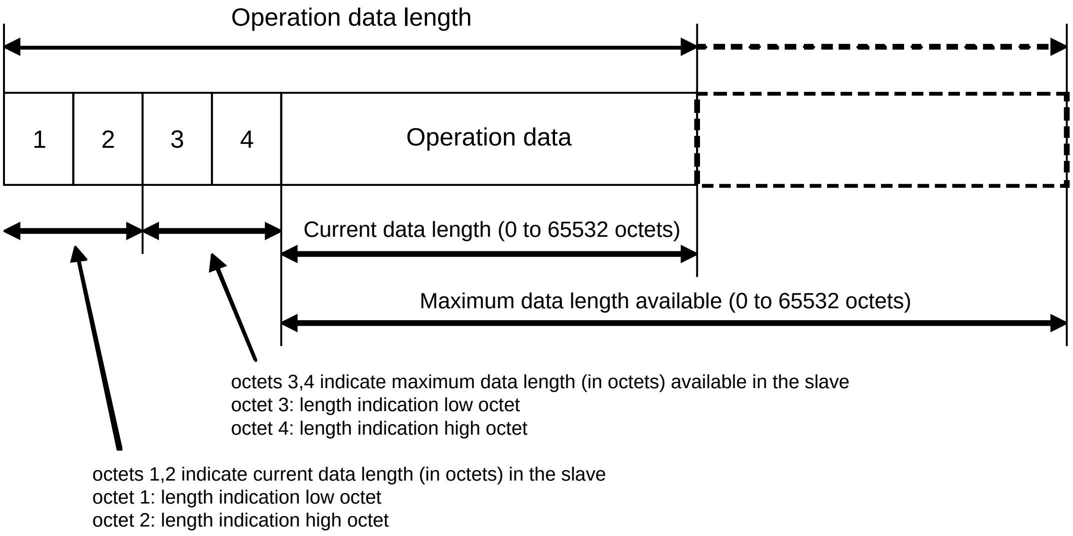

Figure A.3 – Structure of IDN operation data with variable length

Operation data with variable length shall consist of length indicators in the initial four octets, followed by the programmed operation data.

Files or tables shall be loaded from the control unit to the slaves or vice versa by means of the transfer of operation data with variable length (for example the IDN-list of all operation data in a slave).

If the operation data has the length 0, only the two length indications shall be transmitted. Octets 1 and 2 shall then contain the value 0.

Reading: In order to complete a read command in the service channel correctly, the master shall require octets 1 and 2. Octets 3 and 4 shall only be read by the master to prevent writing operation data which is too long.

Writing: When writing operation data, the master shall set octets 1 and 2 according to the current data length. The data shall not be longer than specified in octets 3 and 4. During writing, the slave shall ignore octets 3 and 4 and insert its available length during reading.

Sorting of the IDNs in IDN lists:

IDNs shall be sorted in the IDN lists in one of the following ways:

- Unsorted IDN lists (for example configuration lists)
- Sorted by Function group or data block number (FG)
  - Function group or data block number
  - Structure instance,
  - Structure element.
- Sorted by Structure instance (SI)
  - Structure instance,
  - Function group or data block number
  - Structure element.

Table A.5 shows the structure of an IDN list and the sorting of the IDNs as an example.

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Table A.5 – Example of the structure of an IDN-list

<table>
<tr><th>1. 2.</th><th>3. 4.</th><th colspan="7">← Length of list →</th></tr>
<tr><td>1C 00</td><td>1C 00</td><td colspan="7"></td></tr>
<tr><td></td><td></td><td>S-0-1000</td><td>S-0-1300.
0.2</td><td>S-0-1300.
0.4</td><td>S-0-1502.
0.1</td><td>S-0-1502.
0.2</td><td>S-0-1502.
1.1</td><td>S-0-1502.
1.2</td></tr>
<tr><td></td><td></td><td>List element #0</td><td>List element #1</td><td>List element #2</td><td>List element #3</td><td>List element #4</td><td>List element #5</td><td>List element #6</td></tr>
<tr><td></td><td colspan="8">Octets 3 and 4 indicates the maximum length for operation data available in the slave; example length = 28 octets (0x001C)</td></tr>
<tr><td colspan="9">Octets 1 and 2 indicates the current length for programmed operation data; example length = 28 octets (0x001C)</td></tr>
</table>

A.1.9 Structure of Data status

The content of “data status” shall be related to the entire parameter. “Data status” shall contain conditions which change dynamically. When opening the service channel via an IDN, the current data status shall be transferred automatically to the master. This enables the control unit to respond to procedure command acknowledgments during transmission of a procedure command. The data status (procedure command acknowledgment) shall be reset by the device during every renewed initialization.

Bits 3-0 shall only be present for procedure commands (procedure command acknowledgment).

Changes in the procedure command acknowledgment by:

- bit 3-0: procedure command executed correctly (0111-->0011 = positive acknowledgment), or
- bit 3-0: procedure command execution is impossible (0111-->1111 = negative acknowledgment)

shall lead to setting the procedure command change bit in the device status.

Bit 8 shall be set by the device if the parameter is recognized as invalid, such as if the data memory is checked for data loss and a checksum error is set.

The structure of the data status is shown in Table A.6.

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Table A.6 – Data status structure

Bits	Value	Meaning
15-9	—	(reserved)
8	—	Validity of operation data
	0	Operation data is valid
	1	Operation data is invalid
7-4	—	(reserved)
3-0	—	Procedure command acknowledgment
	0000	Procedure command not activated
	0001	Procedure command is set and the execution is interrupted
	0011	Procedure command executed correctly (positive acknowledgment), procedure command change bit in device status is set to 1
	0111	Procedure command not yet executed (processing)
	1111	Error, procedure command execution is impossible (negative acknowledgment), procedure command change bit in device status is set to 1
		All other codings are reserved

A.2 Identification numbers in numerical orders

Table A.7 lists the IDNs which are related to communication, and that devices of this type shall support. Their detailed description appears in Clause A.3.

Application-specific data content is specified in other relevant standards, for example IEC 61800-7-20x.

Table A.7 – List of relevant communication-related IDNs

IDN number	IDN name
S-0-0014	Interface status
S-0-0021	IDN-list of invalid operation data for CP2
S-0-0022	IDN-list of invalid operation data for CP3
S-0-0026	IDN allocation of producer RTB word container
S-0-0027	IDN allocation of consumer RTB word container
S-0-0127	CP3 transition check
S-0-0128	CP4 transition check
S-0-0144	Producer RTB word container
S-0-0145	Consumer RTB word container
S-0-0187	IDN-list of configurable data as producer
S-0-0188	IDN-list of configurable data as consumer
S-0-0328	Bit allocation of producer RTB word container
S-0-0329	Bit allocation of consumer RTB word container
S-0-0360	MDT data container A1
S-0-0361	MDT data container B1
S-0-0362	MDT data container A list index
S-0-0363	MDT data container B list index
S-0-0364	AT data container A1

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IDN number	IDN name
S-0-0365	AT data container B1
S-0-0366	AT data container A list index
S-0-0367	AT data container B list index
S-0-0368	Data container A pointer
S-0-0369	Data container B pointer
S-0-0370	MDT data container A&B configuration list
S-0-0371	AT data container A&B configuration list
S-0-0394	List IDN
S-0-0396	Number of list elements
S-0-0397	List segment
S-0-0398	IDN list of configurable real-time/status bits
S-0-0399	IDN list of configurable real-time/control bits
S-0-0444	IDN-list of configurable data in the AT data container
S-0-0445	IDN-list of configurable data in the MDT data container
S-0-0450	MDT data container A2
S-0-0451	MDT data container A3
S-0-0452	MDT data container A4
S-0-0453	MDT data container A5
S-0-0454	MDT data container A6
S-0-0455	MDT data container A7
S-0-0456	MDT data container A8
S-0-0457	MDT data container A9
S-0-0458	MDT data container A10
S-0-0459	MDT data container B2
S-0-0480	AT data container A2
S-0-0481	AT data container A3
S-0-0482	AT data container A4
S-0-0483	AT data container A5
S-0-0484	AT data container A6
S-0-0485	AT data container A7
S-0-0486	AT data container A8
S-0-0487	AT data container A9
S-0-0488	AT data container A10
S-0-0489	AT data container B2
S-0-0490	MDT data container A2 configuration list
S-0-0491	MDT data container A3 configuration list
S-0-0492	MDT data container A4 configuration list
S-0-0493	MDT data container A5 configuration list
S-0-0494	MDT data container A6 configuration list
S-0-0495	MDT data container A7 configuration list
S-0-0496	MDT data container A8 configuration list
S-0-0497	MDT data container A9 configuration list
S-0-0498	MDT data container A10 configuration list

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IDN number	IDN name
S-0-0500	AT data container A2 configuration list
S-0-0501	AT data container A3 configuration list
S-0-0502	AT data container A4 configuration list
S-0-0503	AT data container A5 configuration list
S-0-0504	AT data container A6 configuration list
S-0-0505	AT data container A7 configuration list
S-0-0506	AT data container A8 configuration list
S-0-0507	AT data container A9 configuration list
S-0-0508	AT data container A10 configuration list
S-0-1000.0.1	Active SCP Classes
S-0-1000	SCP Type & Version
S-0-1002	Communication cycle time (tScyc)
S-0-1003	Allowed MST losses in CP3/CP4
S-0-1005	Minimum feedback processing time (t5)
S-0-1006	AT transmission starting time (t1)
S-0-1007	Synchronization time (Tsync)
S-0-1008	Command value valid time (t3)
S-0-1009	Device Control (C-DEV) offset in MDT
S-0-1010	Lengths of MDTs
S-0-1011	Device Status (S-DEV) offset in AT
S-0-1012	Lengths of ATs
S-0-1013	SVC offset in MDT
S-0-1014	SVC offset in AT
S-0-1015	Ring delay
S-0-1016	Slave delay (P&S)
S-0-1017	UC channel transmission time
S-0-1019	MAC address
S-0-1020.0.1	Current IP address
S-0-1020	IP address
S-0-1021.0.1	Current subnet mask
S-0-1021	Subnet mask
S-0-1022.0.1	Current gateway address
S-0-1022	Gateway address
S-0-1023	SYNC jitter
S-0-1024	SYNC delay measuring procedure command
S-0-1026	Version of communication hardware
S-0-1027.0.1	Requested MTU
S-0-1027.0.2	Effective MTU
S-0-1028	Error counter MST-P&S
S-0-1031	Test pin assignment Port 1 & Port 2
S-0-1035	Error counter Port 1 & Port 2
S-0-1040	Sub-device address
S-0-1041	AT Command value valid time (t9)

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IDN number	IDN name
S-0-1044	Device control (C-DEV)
S-0-1045	Device status (S-DEV)
S-0-1046	List of sub-device addresses in device
S-0-1047	Maximum consumer activation time (t11)
S-0-1048	Activate network settings
S-0-1050.x.1	Connection setup
S-0-1050.x.2	Connection Number
S-0-1050.x.3	Telegram assignment
S-0-1050.x.4	Max. Length of Connection
S-0-1050.x.5	Current length of Connection
S-0-1050.x.6	Configuration List
S-0-1050.x.7	Assigned connection capability
S-0-1050.x.8	Connection control (C-CON)
S-0-1050.x.10	Producer cycle time
S-0-1050.x.11	Allowed Data Losses
S-0-1050.x.12	Error Counter Data Losses
S-0-1050.x.20	IDN Allocation of real-time bit
S-0-1050.x.21	Bit allocation of real-time bit
S-0-1051	Image of connection setups
S-0-1060.x.01	Default configuration
S-0-1060.x.02	Configuration mask
S-0-1060.x.03	Maximum quantity of this connection capability
S-0-1060.x.04	Max. connection length of connection capability
S-0-1060.x.06	Configurable IDNs of connection capability
S-0-1060.x.07	Maximum processing time
S-0-1060.x.10	Minimum producer cycle time
S-0-1061	Maximum TSref-Counter
S-0-1080.x.02	Producer RTB list container
S-0-1080.x.03	IDN allocation of producer RTB list container
S-0-1080.x.04	Bit allocation of producer RTB list container
S-0-1081.x.02	Consumer RTB list container
S-0-1081.x.03	IDN allocation of consumer RTB list container
S-0-1081.x.04	Bit allocation of consumer RTB list container
S-0-1099.0.01	Test-IDN Control for SCP conformity purpose
S-0-1099.0.02	Test-IDN Container for SCP conformity purpose
S-0-1100.0.01	Diagnostic counter sent SMP fragments
S-0-1100.0.02	Diagnostic counter received SMP fragments
S-0-1100.0.03	Diagnostic counter discarded SMP fragments
S-0-1101.x.01	SMP Container Data
S-0-1101.x.02	List of session identifiers
S-0-1101.x.03	List of session priorities
S-0-1150.x.01	OVS Control (C-OVS)
S-0-1150.x.02	OVS Status (S-OVS)

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IDN number	IDN name
S-0-1150.x.03	OVS Container
S-0-1150.x.04	Sample time
S-0-1150.x.05	Phase shift
S-0-1150.x.06	Configuration List OVS - IDNs
S-0-1150.x.07	Configuration List OVS - Offset
S-0-1150.x.08	Configuration List OVS - Length
S-0-1150.x.09	Assigned Oversampling Capability
S-0-1150.x.10	Number of samples
S-0-1151.x.01	Maximum number of samples
S-0-1151.x.02	Internal resolution
S-0-1151.x.03	Maximum quantity of this oversampling capability
S-0-1151.x.04	Minimum sample time
S-0-1151.x.06	Configurable IDNs of OVS capability
S-0-1151.x.07	Configurable IDNs of OVS capability - Offset
S-0-1151.x.08	Configurable IDNs of OVS capability - Length
S-0-1152	Amount of OVS Domains
NOTE All other IDN numbers are reserved.	

A.3 Detailed specification of communication-related IDNs

A.3.1 IDN S-0-0014 Interface status

A.3.1.1 Attributes

Table A.8 shows the possible attributes for this IDN.

Table A.8 – Attributes for IDN S-0-0014

Attribute	Value
Name	Interface status
Version	—
Length	2
Display Format	binary
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.1.2 Description

If an error is set in the interface status, then the error C1D is set in device status (S-0-1045 Device Status (S-DEV)).

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The setting of bits 2–0 does not signify an error. If there are no communication errors present, the current communication phase is contained in the interface status. If an error has occurred, the error and the current CP will be stored simultaneously.

The error bits of the interface status are reset to '0' by the sub-device only if no errors of interface status exists and after the procedure command S-0-0099 Reset class 1 diagnostic has been received by the sub-device via the service channel.

Table A.9 shows the structure of interface status.

Table A.9 – Structure of interface status

Bit No	Value	Meaning
15	0 = no error 1 = error	Manufacturer-specific error
14		Topology and Communication
13		Phase switching with invalid conditions
12		CPS-MST timeout during phase switching
11		(reserved)
10		(reserved)
9		(reserved)
8		(reserved)
7		(reserved)
6		reserved
5		invalid phase (phase > 4)
4		(reserved)
3		MST failure (S-0-1003 Allowed MST losses in CP3 & CP4)
2-0	000 … 100	CP0 … CP4
	101 … 110	(reserved)
	111	NRT Mode

A.3.2 IDN S-0-0021 IDN-list of invalid operation data for CP2

A.3.2.1 Attributes

Table A.10 shows the possible attributes for this IDN.

Table A.10 – Attributes for IDN S-0-0021

Attribute	Value
Name	IDN-list of invalid operation data for CP2
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1

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Attribute	Value
Unit	—

A.3.2.2 Description

IDNs which are considered invalid by the slave when performing the CP3 transition check are stored in this IDN-list.

- Case 1: procedure command S-0-0127 is performed correctly; the IDN-list (S-0-0021) contains no IDNs.
- Case 2: procedure command S-0-0127 results in an error; the IDN-list (S-0-0021) contains all IDNs of invalid operation data.

The presence of this parameter is only necessary if this slave have the ability for errors during phase switching (S-0-0127).IDN S-0-0022 IDN-list of invalid operation data for CP3.

A.3.2.3 Attributes

Table A.11 shows the possible attributes for this IDN.

Table A.11 – Attributes for IDN S-0-0022

Attribute	Value
Name	IDN-list of invalid operation data for CP3
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.2.4 Description

IDNs which are considered invalid by the slave when performing the CP4 transition check are stored in this IDN-list.

- Case 1: procedure command S-0-0128 is performed correctly; the IDN-list (S-0-0022) contains no IDNs.
- Case 2: procedure command S-0-0128 results in an error; the IDN-list (S-0-0022) contains all IDNs of invalid operation data.

The presence of this parameter is only necessary if this slave have the ability for errors during phase switching (S-0-0128).

A.3.3 IDN S-0-0026 IDN allocation of producer RTB word container

A.3.3.1 Attributes

Table A.12 shows the possible attributes for this IDN.

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Table A.12 – Attributes for IDN S-0-0026

Attribute	Value
Name	IDN allocation of producer RTB word container
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.3.2 Description

Bits in the producer RTB word container (S-0-0144) are definable by means of the configuration list of the producer RTB word container represented in this IDN. The sequence of the IDNs in the configuration list determines the bit numbering scheme in the producer RTB word container. The first IDN of the configuration list defines bit 0, the last IDN defines bit 15 of the producer RTB word container. If IDN S-0-0328 is not supported by the slave, bit 0 of all the configured IDNs are used, else S-0-0328 defines for each IDN which bit is used. Maximum 16 IDNs can be taken into this list, therefore this list shall have a fixed length of 64 octets.

A.3.4 IDN S-0-0027 IDN allocation of consumer RTB word container

A.3.4.1 Attributes

Table A.13 shows the possible attributes for this IDN.

Table A.13 – Attributes for IDN S-0-0027

Attribute	Value
Name	IDN allocation of consumer RTB word container
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.4.2 Description

Bits in the consumer RTB word container (S-0-0145) are definable by means of the configuration list of the consumer RTB word container represented in this IDN. The sequence of the IDNs in the configuration list determines the bit numbering scheme in the consumer

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RTB word container. The first IDN of the configuration list defines bit 0, the last IDN defines bit 15 of the consumer RTB word container. If IDN S-0-0329 is not supported by the slave, bit 0 of all the configured IDNs are used, else S-0-0329 defines for each IDN which bit is used. Maximum 16 IDNs can be taken into this list, therefore this list shall have a fixed length 64 octets.

A.3.5 IDN S-0-0127 CP3 transition check

A.3.5.1 Attributes

Table A.14 shows the possible attributes for this IDN.

Table A.14 – Attributes for IDN S-0-0127

Attribute	Value
Name	CP3 transition check
Version	—
Length	2
Display Format	Binary
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.5.2 Description

The master uses this procedure command to instruct the slave to check that all necessary parameters have been transferred for CP3. Otherwise, this procedure command results in an error (see S-0-0021). After the procedure command is performed correctly, the master has to cancel the procedure command. The master can then activate CP3 in the MST.

A.3.6 IDN S-0-0128 CP4 transition check

A.3.6.1 Attributes

Table A.15 shows the possible attributes for this IDN.

Table A.15 – Attributes for IDN S-0-0128

Attribute	Value
Name	CP4 transition check
Version	—
Length	2
Display Format	binary
Min input value	—
Max input value	—

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Attribute	Value
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.6.2 Description

The master uses this procedure command to instruct the slave to check that all necessary parameters have been transferred for CP4. Otherwise, this procedure command results in an error (see S-0-0022). After the procedure command is performed correctly, the master has to cancel the procedure command. The master can then activate CP4 in the MST.

A.3.7 IDN S-0-0144 Producer RTB word container

A.3.7.1 Attributes

Table A.16 shows the possible attributes for this IDN.

Table A.16 – Attributes for IDN S-0-0144

Attribute	Value
Name	Producer RTB word container
Version	—
Length	2
Display Format	Binary
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.7.2 Description

Signals can be transmitted in real-time from the producer to the consumer by means of the producer RTB word container. For this purpose, the producer RTB word container needs to be integrated in one or more producer connections.

Bits in the producer RTB word container are defined by means of the configuration lists of the producer RTB word container (see S-0-0026 and S-0-0328).

A.3.8 IDN S-0-0145 Consumer RTB word container

A.3.8.1 Attributes

Table A.17 shows the possible attributes for this IDN.

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Table A.17 – Attributes for IDN S-0-0027

Attribute	Value
Name	Consumer RTB word container
Version	—
Length	2
Display Format	Binary
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.8.2 Description

Signals can be transmitted in real-time from the producer to the consumer by means of the consumer RTB word container. For this purpose, the consumer RTB word container needs to be integrated in one consumer connection.

Bits in the consumer RTB word container are definable by means of the configuration lists of the consumer RTB word container (see S-0-0027 and S-0-0329).

A.3.9 IDN S-0-0187 IDN-list of configurable data as producer

A.3.9.1 Attributes

Table A.18 shows the possible attributes for this IDN.

Table A.18 – Attributes for IDN S-0-0187

Attribute	Value
Name	IDN-list of configurable data as producer
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.9.2 Description

This IDN list contains all IDNs of operation data of the producer (for example: feedback values, inputs) which can be processed by the sub-device cyclically in the AT.

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If S-0-1060 exists you will find more detailed information of the connection related parameter.

A.3.10 IDN S-0-0188 IDN-list of configurable data as consumer

A.3.10.1 Attributes

Table A.19 shows the possible attributes for this IDN.

Table A.19 – Attributes for IDN S-0-0188

Attribute	Value
Name	IDN-list of configurable data as consumer
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.10.2 Description

This IDN list contains all IDNs of operation data (command values) which can be processed by the sub-device cyclically.

If S-0-1060 exists you will find more detailed information of the connection related parameter.

A.3.11 IDN S-0-0328 Bit allocation of producer RTB word container

A.3.11.1 Attributes

Table A.20 shows the possible attributes for this IDN.

Table A.20 – Attributes for IDN S-0-0328

Attribute	Value
Name	Bit allocation of producer RTB word container
Version	—
Length	2, variable
Display Format	Unsigned decimal (bit number)
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

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A.3.11.2 Description

In this configuration list the bit numbers of the operation data are programmed, which are copied into the producer RTB word container (S-0-0144). The sequence of the bit numbers in the configuration list sets the numerical order in the producer RTB word container. The first bit number in the configuration list sets bit 0, the last bit number sets bit 15 into the producer RTB word container. Maximum one 16 bit number can be taken into this list, therefore this list shall have a fixed length of 32 octets (see also S-0-0026).

A.3.12 IDN S-0-0329 Bit allocation of consumer RTB word container

A.3.12.1 Attributes

Table A.21 shows the possible attributes for this IDN.

Table A.21 – Attributes for IDN S-0-0329

Attribute	Value
Name	Bit allocation of consumer RTB word container
Version	—
Length	2, variable
Display Format	Unsigned decimal (bit number)
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.12.2 Description

In this configuration list the bit numbers of the operation data are programmed, which are contained in the consumer RTB word container (S-0-0145). The sequence of the bit numbers in the configuration list sets the numerical order in the consumer RTB word container. The first bit number in the configuration list sets bit 0, the last bit number sets bit 15 in the consumer RTB word container. Maximum 16 bit number can be taken into this list, therefore this list shall have a fixed length of 32 octets (see also S-0-0027).

A.3.13 IDN S-0-0360 MDT data container A1

A.3.13.1 Attributes

Table A.22 shows the possible attributes for this IDN.

Table A.22 – Attributes for IDN S-0-0360

Attribute	Value
Name	MDT data container A1
Version	—
Length	4
Display Format	Hexadecimal
Min input value	—

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Attribute	Value
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.13.2 Description

For the standard data container function in the MDT,

- two data containers (4 octets long, A1 and B1) and
- two data containers (8 octets long, A9 and B2)

are defined, serving as placeholders in the MDT. The contents of the data containers can be dynamically changed by the master as necessary. Additionally, the data container A pointer (S-0-0368) is required for the containers A1 and A9 (S-0-0360 and S-0-0457). The data container B pointer (S-0-0369) is required for the containers B1 and B2 (S-0-0361 and S-0-0459) as well as one configuration list (S-0-0370) for all MDT container. If the configured operation data is only 2 or 4 octets long, it is placed in the lower part of the MDT data container. The higher part is not used.

In configuring data container operation data, the slave can select between a minimum requirement and maximum requirement.

- Minimum required data block (access via service channel):
  - The configured operation data is represented in the data container in hexadecimal, without the units.
    - Attribute: Data type and display format’ are set hexadecimal (bits 22-20 = 011)
    - Units: Not present
- Maximum required data block (access via service channel):

The configured operation data is represented in the data container not with the data block of the data container itself, rather the configured operation data’s data block. In this case the operation data will be displayed with the IDN of the data container exactly the same as it would be with its own IDN.

NOTE The MDT data container A1 (S-0-0360) and A9 (S-0-0457) are used also in the extended data container function.

A.3.14 IDN S-0-0361 MDT data container B1

A.3.14.1 Attributes

Table A.23 shows the possible attributes for this IDN.

Table A.23 – Attributes for IDN S-0-0361

Attribute	Value
Name	MDT data container B1
Version	—
Length	4
Display Format	Hexadecimal

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Attribute	Value
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.14.2 Description

For the standard data container function in the MDT,

- two data containers (4 octets long, A1 and B1) and
- two data containers (8 octets long, A9 and B2)

are defined, serving as placeholders in the MDT. The contents of the data containers can be dynamically changed by the master as necessary. Additionally, the data container A pointer (S-0-0368) is required for the containers A1 and A9 (S-0-0360 and S-0-0457). The data container B pointer (S-0-0369) is required for the containers B1 and B2 (S-0-0361 and S-0-0459) as well as one configuration list (S-0-0370) for all MDT container. If the configured operation data is only 2 or 4 octets long, it is placed in the lower part of the MDT data container. The higher part is not used.

In configuring data container operation data, the slave can select between a minimum requirement and maximum requirement.

- Minimum required data block (access via service channel):
  – The configured operation data is represented in the data container in hexadecimal, without the units.
    - Attribute: Data type and display format' are set hexadecimal (bits 22-20 = 011)
    - Units: Not present
- Maximum required data block (access via service channel):
  – The configured operation data is represented in the data container not with the data block of the data container itself, rather the configured operation data's data block. In this case the operation data will be displayed with the IDN of the data container exactly the same as it would be with its own IDN.

NOTE The MDT data container A1 (S-0-0360) and A9 (S-0-0457) are used also in the extended data container function.

A.3.15 IDN S-0-0362 MDT data container A list index

A.3.15.1 Attributes

Table A.24 shows the possible attributes for this IDN.

Table A.24 – Attributes for IDN S-0-0362

Attribute	Value
Name	MDT data container A list index
Version	—
Length	2
Display Format	Hexadecimal

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Attribute	Value
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.15.2 Description

If in the MDT data container an IDN with a variable length (list parameter) is configured,

- the corresponding list element of this list parameter will be addressed via the list index,
- the master writes the addressed list element into the MDT data container.

The list index of the MDT data container consists of a 16 bit address. Via list index 65535 the MDT data container can be defined not valid by the master.

The list index of MDT data container can be configured in the cyclic data of the MDT. Thereby, a switching of the list elements in the MDT data container during the next communication cycle is possible.

If the list index is situated outside of the list parameter, the data in the corresponding MDT data containers will be ignored by the slave. In this case the slave shall set the list index (acknowledgment) on value 65535 and optionally the pointer of MDT data container on value 255.

The list index of MDT data container (see Table A.25) can also be configured into the cyclic data of the ATs. In this way an acknowledgment of the MDT data container is possible. The slave reads the list index of MDT data container from the MDT and acknowledges it in the AT.

Table A.25 – List index of MDT data container A

Bit number	Value	Description
15-0	MDT data container A list index structure:	
	0-65534	index of the configured list parameter
	65535	MDT data container A not valid (error)

A.3.16 IDN S-0-0363 MDT data container B list index

A.3.16.1 Attributes

Table A.26 shows the possible attributes for this IDN.

Table A.26 – Attributes for IDN S-0-0363

Attribute	Value
Name	MDT data container B list index
Version	—
Length	2
Display Format	Hexadecimal

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Attribute	Value
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.16.2 Description

If in the MDT data container an IDN with a variable length (list parameter) is configured,

- the corresponding list element of this list parameter will be addressed via the list index,
- the master writes the addressed list element into the MDT data container.

The list index of the MDT data container consists of a 16 bit address. Via list index 65535 the MDT data container can be defined not valid by the master.

The list index of MDT data container can be configured in the cyclic data of the MDT. Thereby, a switching of the list elements in the MDT data container during the next communication cycle is possible.

If the list index is situated outside of the list parameter, the data in the corresponding MDT data containers will be ignored by the slave. In this case the slave shall set the list index (acknowledgment) on value 65535 and optionally the pointer of MDT data container on value 255.

The list index of MDT data container (see Table A.27) can also be configured into the cyclic data of the ATs. In this way an acknowledgment of the MDT data container is possible. The slave reads the list index of MDT data container from the MDT and acknowledges it in the AT.

Table A.27 – List index of MDT data container B

Bit number	Value	Description
15-0	MDT data container B list index structure:	
	0-65534	index of the configured list parameter
	65535	MDT data container B not valid (error)

A.3.17 IDN S-0-0364 AT data container A1

A.3.17.1 Attributes

Table A.28 shows the possible attributes for this IDN.

Table A.28 – Attributes for IDN S-0-0364

Attribute	Value
Name	AT data container A1
Version	—
Length	4
Display Format	Hexadecimal

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Attribute	Value
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.17.2 Description

For the standard data container function in the AT

- two data containers (4 octets long, A1 and B1) and
- two data containers (8 octets long, A9 and B2)

are defined, serving as placeholders in the AT. The contents of the data containers can be dynamically changed by the master as necessary. Additionally, the data container A pointer (S-0-0368) is required for the containers A1 and A9 (S-0-0364 and S-0-0487). The data container B pointer (S-0-0369) is required for the containers B1 and B2 (S-0-0365 and S-0-0489) as well as one configuration list (S-0-0371) for all AT container. If the configured operation data is only 2 or 4 octets long, it is placed in the lower part of the AT data container. The higher part is not used.

In configuring data container operation data, the slave can select between a minimum requirement and maximum requirement.

- Minimum required data block (access via service channel):
  - The configured operation data is represented in the data container in hexadecimal, without the units.
    - Attribute: Data type and display format' are set hexadecimal (bits 22-20 = 011)
    - Units: Not present
- Maximum required data block (access via service channel):
  - The configured operation data is represented in the data container not with the data block of the data container itself, rather the configured operation data's data block. In this case the operation data will be displayed with the IDN of the data container exactly the same as it would be with its own IDN.

NOTE The AT data container A1 (S-0-0364) and A9 (S-0-0487) are used also in the extended data container function.

A.3.18 IDN S-0-0365 AT data container B1

A.3.18.1 Attributes

Table A.29 shows the possible attributes for this IDN.

Table A.29 – Attributes for IDN S-0-0365

Attribute	Value
Name	AT data container B1
Version	—
Length	4
Display Format	Hexadecimal

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Attribute	Value
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.18.2 Description

For the standard data container function in the AT

- two data containers (4 octets long, A1 and B1) and
- two data containers (8 octets long, A9 and B2)

are defined, serving as placeholders in the AT. The contents of the data containers can be dynamically changed by the master as necessary. Additionally, the data container A pointer (S-0-0368) is required for the containers A1 and A9 (S-0-0364 and S-0-0487). The data container B pointer (S-0-0369) is required for the containers B1 and B2 (S-0-0365 and S-0-0489) as well as one configuration list (S-0-0371) for all AT container. If the configured operation data is only 2 or 4 octets long, it is placed in the lower part of the AT data container. The higher part is not used.

In configuring data container operation data, the slave can select between a minimum requirement and maximum requirement.

- Minimum required data block (access via service channel):
  - The configured operation data is represented in the data container in hexadecimal, without the units.
    - Attribute: Data type and display format' are set hexadecimal (bits 22-20 = 011)
    - Units: Not present
- Maximum required data block (access via service channel):
  - The configured operation data is represented in the data container not with the data block of the data container itself, rather the configured operation data's data block. In this case the operation data will be displayed with the IDN of the data container exactly the same as it would be with its own IDN.

NOTE The AT data container A1 (S-0-0364) and A9 (S-0-0487) are used also in the extended data container function.

A.3.19 IDN S-0-0366 AT data container A list index

A.3.19.1 Attributes

Table A.30 shows the possible attributes for this IDN.

Table A.30 – Attributes for IDN S-0-0366

Attribute	Value
Name	AT data container A list index
Version	—
Length	2
Display Format	Hexadecimal

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Attribute	Value
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.19.2 Description

If in the AT data container an IDN with a variable length (list parameter) is configured,

- the corresponding list element of this list parameter will be addressed via the list index,
- the slave writes the addressed list element into the AT data container.

The list index of the AT data container consists of a 16 bit address. Via list index 65535 the AT data container can be defined not valid by the slave.

The list index of AT data container can be configured in the cyclic data of the MDT. Thereby, a switching of the list elements in the AT data container during the next communication cycle is possible.

If the list index is situated outside of the list parameter, the data in the corresponding AT data containers will be ignored by the master. In this case the slave shall set the list index (acknowledgment) on value 65535 and optionally the pointer of AT data container on value 255.

The list index of AT data container (Table A.31) can also be configured into the cyclic data of the ATs. In this way an acknowledgment of the AT data container is possible. The slave reads the list index of AT data container from the MDT and acknowledges it in the AT.

Table A.31 – List index of AT data container A

Bit number	Value	Description
15-0	AT data container A list index structure:	
	0-65534	index of the configured list parameter
	65535	AT data container A not valid (error)

A.3.20 IDN S-0-0367 AT data container B list index

A.3.20.1 Attributes

Table A.32 shows the possible attributes for this IDN.

Table A.32 – Attributes for IDN S-0-0367

Attribute	Value
Name	AT data container B list index
Version	—
Length	2
Display Format	Hexadecimal

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Attribute	Value
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.20.2 Description

If in the AT data container an IDN with a variable length (list parameter) is configured,

- the corresponding list element of this list parameter will be addressed via the list index.
- The slave writes the addressed list element into the AT data container.

The list index of the AT data container consists of a 16 bit address. Via list index 65535 the AT data container can be defined not valid by the slave.

The list index of AT data container can be configured in the cyclic data of the MDT. Thereby, a switching of the list elements in the AT data container during the next communication cycle is possible.

If the list index is situated outside of the list parameter, the data in the corresponding AT data containers will be ignored by the master. In this case the slave shall set the list index (acknowledgment) on value 65535 and optionally the pointer of AT data container on value 255.

The list index of AT data container (Table A.33) can also be configured into the cyclic data of the ATs. In this way an acknowledgment of the AT data container is possible. The slave reads the list index of AT data container from the MDT and acknowledges it in the AT.

Table A.33 – List index of AT data container B

Bit number	Value	Description
15-0	AT data container B list index structure:	
	0-65534	index of the configured list parameter
	65535	AT data container B not valid (error)

A.3.21 IDN S-0-0368 Data container A pointer

A.3.21.1 Attributes

Table A.34 shows the possible attributes for this IDN.

Table A.34 – Attributes for IDN S-0-0368

Attribute	Value
Name	Data container A pointer
Version	—
Length	2
Display Format	hexadecimal

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Attribute	Value
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.21.2 Description

The data container pointers contain an 8-bit pointer, that defines which operation data should be placed in the MDT and AT data container. The data container pointer is the offset, within the corresponding data container configuration list

- for standard data container S-0-0370 and S-0-0371,
- additionally for extended data container S-0-0490 to S-0-0498 and S-0-0500 to S-0-0508.

Herewith inside the configuration list an IDN is addressed for the MDT data container or AT data container.

The master writes the addressed operation data into the MDT data container. The slave writes the addressed operation data into the AT data container.

The IDN "Data container A pointer and B pointer" (S-0-0368, S-0-0369) can be configured in the cyclic data of the MDT. Thereby, a switching of the operation data in the data containers during the next communication cycle is possible.

The IDN "Data container A pointer and B pointer" (S-0-0368, S-0-0369) can also be configured in the cyclic data of the AT. In this case the addressing (acknowledgment) according to the contents of the data container will be transmitted. The slave generates the acknowledgment by copying the pointer of MDT to the pointer of AT.

If the pointer of the data container (Table A.35) is situated outside of the configuration list for the MDT or AT data container or the data is longer than the data container, the contents of the data container are not valid. The slave sets the pointer (acknowledgment) in the AT on 255. The data in MDT or AT data container will be ignored by the slave or master.

Table A.35 – Data container A pointer structure

Bit number	Value	Description
15-8	—	Address for AT data container
	0-254	address for AT data container A
	255	AT data container A not valid (error)
7-0	—	Address for MDT data container
	0-254	address for MDT data container A
	255	MDT data container not valid (error)

A.3.22 IDN S-0-0369 Data container B pointer

A.3.22.1 Attributes

Table A.36 shows the possible attributes for this IDN.

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Table A.36 – Attributes for IDN S-0-0369

Attribute	Value
Name	Data container B pointer
Version	—
Length	2
Display Format	hexadecimal
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.22.2 Description

The data container pointers contain an 8-bit pointer, that defines which operation data should be placed in the MDT and AT data container. The data container pointer is the offset, within the corresponding data container configuration list

- for standard data container S-0-0370 and S-0-0371,
- additionally for extended data container S-0-0490 to S-0-0498 and S-0-0500 to S-0-0508.

Herewith inside the configuration list an IDN is addressed for the MDT data container or AT data container.

The master writes the addressed operation data into the MDT data container. The slave writes the addressed operation data into the AT data container.

The IDN "Data container A pointer and B pointer" (S-0-0368, S-0-0369) can be configured in the cyclic data of the MDT. Thereby, a switching of the operation data in the data containers during the next communication cycle is possible.

The IDN "Data container A pointer and B pointer" (S-0-0368, S-0-0369) can also be configured in the cyclic data of the AT. In this case the addressing (acknowledgment) according to the contents of the data container will be transmitted. The slave generates the acknowledgment by copying the pointer of MDT to the pointer of AT.

If the pointer of the data container (Table A.37) is situated outside of the configuration list for the MDT or AT data container or the data is longer than the data container, the contents of the data container are not valid. The slave sets the pointer (acknowledgment) in the AT on 255. The data in MDT or AT data container will be ignored by the slave or master.

Table A.37 – Data container B pointer structure

Bit number	Value	Description
15-8	—	Address for AT data container
	0-254	address for AT data container B
	255	AT data container A not valid (error)
7-0	—	Address for MDT data container
	0-254	address for MDT data container B

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Bit number	Value	Description
	255	MDT data container not valid (error)

A.3.23 IDN S-0-0370 MDT data container A/B configuration list

A.3.23.1 Attributes

Table A.38 shows the possible attributes for this IDN.

Table A.38 – Attributes for IDN S-0-0370

Attribute	Value
Name	MDT data container A/B configuration list
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.23.2 Description

The Master enters into the MDT data container configuration list the IDN numbers for the operation data that are to be sent via the corresponding MDT data containers (A and B of standard data container, and A1 to A10 of extended data container) as needed from the master to the slave.

The IDNs in this IDN list may be taken from S-0-0445 IDN-list of configurable data in the MDT data container or from S-0-0188 IDN-list of configurable data as consumer, if S-0-0445 does not exist.

A.3.24 IDN S-0-0371 AT data container A/B configuration list

A.3.24.1 Attributes

Table A.39 shows the possible attributes for this IDN.

Table A.39 – Attributes for IDN S-0-0371

Attribute	Value
Name	AT data container A/B configuration list
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—

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Attribute	Value
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.24.2 Description

The Master enters into the AT data container configuration list the IDN numbers for the operation data that are to be sent via the corresponding AT data containers (A and B of standard data container, and A1 to A10 of extended data container) as needed from the slave to the master.

The IDNs in this IDN list may be taken from S-0-0444 or from S-0-0187, if S-0-0444 does not exist.

A.3.25 IDN S-0-0394 List IDN

A.3.25.1 Attributes

Table A.40 shows the possible attributes for this IDN.

Table A.40 – Attributes for IDN S-0-0394

Attribute	Value
Name	List IDN
Version	—
Length	4
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.25.2 Description

The ident number of a parameter with variable length is stored in this parameter. This parameter shall be interpreted only if the list segment (S-0-0397) is accessed.

A.3.26 IDN S-0-0395 List index

A.3.26.1 Attributes

Table A.41 shows the possible attributes for this IDN.

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Table A.41 – Attributes for IDN S-0-0395

Attribute	Value
Name	List index
Version	—
Length	2
Display Format	unsigned decimal
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.26.2 Description

The list index specifies the starting address inside the list. With list index = 0, the first list element is accessed after the lengths indication. The list index is always programmed according to the list elements.

- List index = 0 -> 1. List element (1, 2, 4 or 8 octets long)
- List index = 1 -> 2. List element (1, 2, 4 or 8 octets long) etc.

The list index shall be in the range between the first list element and the last list element + 1. It is not possible to place a gap in a list but it is possible to extend the list at the end up to its maximum length.

A.3.27 IDN S-0-0396 Number of list elements

A.3.27.1 Attributes

Table A.42 shows the possible attributes for this IDN.

Table A.42 – Attributes for IDN S-0-0396

Attribute	Value
Name	Number of list elements
Version	—
Length	2
Display Format	unsigned decimal
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

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A.3.27.2 Description

This parameter stores the number of list elements which shall be transmitted. The number counts list elements, not octets. The calculation of the length in octets shall be done by the device itself. At a read access the slave generates the current length in octets of the list segment. For write access this parameter shall be ignored. The length information for write access is stored in the current length of the list segment.

A.3.28 IDN S-0-0397 List segment

A.3.28.1 Attributes

Table A.43 shows the possible attributes for this IDN.

Table A.43 – Attributes for IDN S-0-0397

Attribute	Value
Name	List segment
Version	—
Length	like configured data, variable
Display Format	like configured data
Min input value	like configured data
Max input value	like configured data
Positions after decimal point	like configured data
Write protection	Not defined
Conversion factor	1
Scaling/resolution	like configured data
Unit	

A.3.28.2 Description

With the access of this IDN the slave shall evaluate and save the contents of the IDNs S-0-0394, S-0-0395 and if necessary S-0-0396. Modifications at these 3 parameters get effective only with an element change in the service channel.

- Read access
  - The slave provides a list depending on the contents of list index and number of list elements. The current length is calculated by the slave (number of list elements * element width). The maximum length of the list segment shall be set to the current length of the list IDN (S-0-0394).
  - Access to any element excepting element 7 shall provide a copy of the corresponding element of the parameter stored in S-0-0394.
- Write access
  - IDN S-0-0396 shall be ignored on write accesses.
  - The current length of the list segment shall be used in the slave.
  - Only Element 7 shall be writeable.
  - A write access overwrites existing list elements. It shall not be possible to paste a list segments in the destination list. It is possible to extend a list with a list segment at the end of the list up to its maximum length.
  - The list segment immediately gets effective. It behaves so as if the complete list had been written.

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A.3.29 IDN S-0-0398 IDN list of configurable real-time bits as producer

A.3.29.1 Attributes

Table A.44 shows the possible attributes for this IDN.

Table A.44 – Attributes for IDN S-0-0398

Attribute	Value
Name	IDN list of configurable real-time bits as producer
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.29.2 Description

This IDN list contains ident numbers, whose bits are configurable as real-time bits in a producer connection.

A.3.30 IDN S-0-0399 IDN list of configurable real-time bits as consumer

A.3.30.1 Attributes

Table A.45 shows the possible attributes for this IDN.

Table A.45 – Attributes for IDN S-0-0399

Attribute	Value
Name	IDN list of configurable real-time bits as consumer
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.30.2 Description

This IDN list contains ident numbers, whose bits are configurable as real-time bits in a consumer connection.

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A.3.31 IDN S-0-0444 IDN-list of configurable data in the AT data container

A.3.31.1 Attributes

Table A.46 shows the possible attributes for this IDN.

Table A.46 – Attributes for IDN S-0-0444

Attribute	Value
Name	IDN-list of configurable data in the AT data container
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.31.2 Description

This list contains the IDNs of operation data which can be processed by the sub-device in the AT data containers. This IDN list is used in the standard and extended data container.

A.3.32 IDN S-0-0445 IDN-list of configurable data in the MDT data container

A.3.32.1 Attributes

Table A.47 shows the possible attributes for this IDN.

Table A.47 – Attributes for IDN S-0-0445

Attribute	Value
Name	IDN-list of configurable data in the MDT data container
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.32.2 Description

This list contains the IDNs of operation data which can be processed by the sub-device in the MDT data containers. This IDN list is used in the standard and extended data container.

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A.3.33 IDN S-0-0450 MDT data container A2

A.3.33.1 Attributes

Table A.48 shows the possible attributes for this IDN.

Table A.48 – Attributes for IDN S-0-0450

Attribute	Value
Name	MDT data container A2
Version	—
Length	4
Display Format	Hexadecimal
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.33.2 Description

For the extended data container function in the MDT,

- eight data containers (4 octets long, A1 to A8) and
- two data containers (8 octets long, A9 and A10)

are defined, serving as placeholders in the MDT. The contents of the data containers can be dynamically changed by the master as necessary. Additionally, the data container A pointer (S-0-0368) is required for the containers A1 to A10 (S-0-0360, S-0-0450 to S-0-0458), as well as a configuration list (S-0-0370, S-0-0490 to S-0-0498) for each of the MDT container. If the configured operation data is only 2 or 4 octets long, it is placed in the lower part of the MDT data container. The higher part is not used.

In configuring data container operation data, the slave can select between a minimum requirement and maximum requirement.

- Minimum required data block (access via service channel):
  - The configured operation data is represented in the data container in hexadecimal, without the units.
    - Attribute: Data type and display format' are set hexadecimal (bits 22-20 = 011)
    - Units: Not present
- Maximum required data block (access via service channel):
  - The configured operation data is represented in the data container not with the data block of the data container itself, rather the configured operation data's data block. In this case the operation data will be displayed with the IDN of the data container exactly the same as it would be with its own IDN.

A.3.34 IDN S-0-0451 MDT data container A3

A.3.34.1 Attributes

Table A.49 shows the possible attributes for this IDN.

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Table A.49 – Attributes for IDN S-0-0451

Attribute	Value
Name	MDT data container A3
Version	—
Length	4
Display Format	Hexadecimal
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.34.2 Description

For the extended data container function in the MDT,

- eight data containers (4 octets long, A1 to A8) and
- two data containers (8 octets long, A9 and A10)

are defined, serving as placeholders in the MDT. The contents of the data containers can be dynamically changed by the master as necessary. Additionally, the data container A pointer (S-0-0368) is required for the containers A1 to A10 (S-0-0360, S-0-0450 to S-0-0458), as well as a configuration list (S-0-0370, S-0-0490 to S-0-0498) for each of the MDT container. If the configured operation data is only 2 or 4 octets long, it is placed in the lower part of the MDT data container. The higher part is not used.

In configuring data container operation data, the slave can select between a minimum requirement and maximum requirement.

- Minimum required data block (access via service channel):
  – The configured operation data is represented in the data container in hexadecimal, without the units.
    - Attribute: Data type and display format' are set hexadecimal (bits 22-20 = 011)
    - Units: Not present
- Maximum required data block (access via service channel):
  – The configured operation data is represented in the data container not with the data block of the data container itself, rather the configured operation data's data block. In this case the operation data will be displayed with the IDN of the data container exactly the same as it would be with its own IDN.

A.3.35 IDN S-0-0452 MDT data container A4

A.3.35.1 Attributes

Table A.50 shows the possible attributes for this IDN.

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Table A.50 – Attributes for IDN S-0-0452

Attribute	Value
Name	MDT data container A4
Version	—
Length	4
Display Format	Hexadecimal
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.35.2 Description

For the extended data container function in the MDT,

- eight data containers (4 octets long, A1 to A8) and
- two data containers (8 octets long, A9 and A10)

are defined, serving as placeholders in the MDT. The contents of the data containers can be dynamically changed by the master as necessary. Additionally, the data container A pointer (S-0-0368) is required for the containers A1 to A10 (S-0-0360, S-0-0450 to S-0-0458), as well as a configuration list (S-0-0370, S-0-0490 to S-0-0498) for each of the MDT container. If the configured operation data is only 2 or 4 octets long, it is placed in the lower part of the MDT data container. The higher part is not used.

In configuring data container operation data, the slave can select between a minimum requirement and maximum requirement.

- Minimum required data block (access via service channel):
  – The configured operation data is represented in the data container in hexadecimal, without the units.
    - Attribute: Data type and display format' are set hexadecimal (bits 22-20 = 011)
    - Units: Not present
- Maximum required data block (access via service channel):
  – The configured operation data is represented in the data container not with the data block of the data container itself, rather the configured operation data's data block. In this case the operation data will be displayed with the IDN of the data container exactly the same as it would be with its own IDN.

A.3.36 IDN S-0-0453 MDT data container A5

A.3.36.1 Attributes

Table A.51 shows the possible attributes for this IDN.

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Table A.51 – Attributes for IDN S-0-0453

Attribute	Value
Name	MDT data container A5
Version	—
Length	4
Display Format	Hexadecimal
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.36.2 Description

For the extended data container function in the MDT,

- eight data containers (4 octets long, A1 to A8) and
- two data containers (8 octets long, A9 and A10)

are defined, serving as placeholders in the MDT. The contents of the data containers can be dynamically changed by the master as necessary. Additionally, the data container A pointer (S-0-0368) is required for the containers A1 to A10 (S-0-0360, S-0-0450 to S-0-0458), as well as a configuration list (S-0-0370, S-0-0490 to S-0-0498) for each of the MDT container. If the configured operation data is only 2 or 4 octets long, it is placed in the lower part of the MDT data container. The higher part is not used.

In configuring data container operation data, the slave can select between a minimum requirement and maximum requirement.

- Minimum required data block (access via service channel):
  - The configured operation data is represented in the data container in hexadecimal, without the units.
    - Attribute: Data type and display format' are set hexadecimal (bits 22-20 = 011)
    - Units: Not present
- Maximum required data block (access via service channel):
  - The configured operation data is represented in the data container not with the data block of the data container itself, rather the configured operation data's data block. In this case the operation data will be displayed with the IDN of the data container exactly the same as it would be with its own IDN.

A.3.37 IDN S-0-0454 MDT data container A6

A.3.37.1 Attributes

Table A.52 shows the possible attributes for this IDN.

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Table A.52 – Attributes for IDN S-0-0454

Attribute	Value
Name	MDT data container A6
Version	—
Length	4
Display Format	Hexadecimal
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.37.2 Description

For the extended data container function in the MDT,

- eight data containers (4 octets long, A1 to A8) and
- two data containers (8 octets long, A9 and A10)

are defined, serving as placeholders in the MDT. The contents of the data containers can be dynamically changed by the master as necessary. Additionally, the data container A pointer (S-0-0368) is required for the containers A1 to A10 (S-0-0360, S-0-0450 to S-0-0458), as well as a configuration list (S-0-0370, S-0-0490 to S-0-0498) for each of the MDT container. If the configured operation data is only 2 or 4 octets long, it is placed in the lower part of the MDT data container. The higher part is not used.

In configuring data container operation data, the slave can select between a minimum requirement and maximum requirement.

- Minimum required data block (access via service channel):
  – The configured operation data is represented in the data container in hexadecimal, without the units.
    - Attribute: Data type and display format' are set hexadecimal (bits 22-20 = 011)
    - Units: Not present
- Maximum required data block (access via service channel):
  – The configured operation data is represented in the data container not with the data block of the data container itself, rather the configured operation data's data block. In this case the operation data will be displayed with the IDN of the data container exactly the same as it would be with its own IDN.

A.3.38 IDN S-0-0455 MDT data container A7

A.3.38.1 Attributes

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Table A.53 – Attributes for IDN S-0-0455

Attribute	Value
Name	MDT data container A7
Version	—
Length	4
Display Format	Hexadecimal
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.38.2 Description

For the extended data container function in the MDT,

- eight data containers (4 octets long, A1 to A8) and
- two data containers (8 octets long, A9 and A10)

are defined, serving as placeholders in the MDT. The contents of the data containers can be dynamically changed by the master as necessary. Additionally, the data container A pointer (S-0-0368) is required for the containers A1 to A10 (S-0-0360, S-0-0450 to S-0-0458), as well as a configuration list (S-0-0370, S-0-0490 to S-0-0498) for each of the MDT container. If the configured operation data is only 2 or 4 octets long, it is placed in the lower part of the MDT data container. The higher part is not used.

In configuring data container operation data, the slave can select between a minimum requirement and maximum requirement.

- Minimum required data block (access via service channel):
  - The configured operation data is represented in the data container in hexadecimal, without the units.
    - Attribute: Data type and display format' are set hexadecimal (bits 22-20 = 011)
    - Units: Not present
- Maximum required data block (access via service channel):
  - The configured operation data is represented in the data container not with the data block of the data container itself, rather the configured operation data's data block. In this case the operation data will be displayed with the IDN of the data container exactly the same as it would be with its own IDN.

A.3.39 IDN S-0-0456 MDT data container A8

A.3.39.1 Attributes

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Table A.54 – Attributes for IDN S-0-0456

Attribute	Value
Name	MDT data container A8
Version	—
Length	4
Display Format	Hexadecimal
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.39.2 Description

For the extended data container function in the MDT,

- eight data containers (4 octets long, A1 to A8) and
- two data containers (8 octets long, A9 and A10)

are defined, serving as placeholders in the MDT. The contents of the data containers can be dynamically changed by the master as necessary. Additionally, the data container A pointer (S-0-0368) is required for the containers A1 to A10 (S-0-0360, S-0-0450 to S-0-0458), as well as a configuration list (S-0-0370, S-0-0490 to S-0-0498) for each of the MDT container. If the configured operation data is only 2 or 4 octets long, it is placed in the lower part of the MDT data container. The higher part is not used.

In configuring data container operation data, the slave can select between a minimum requirement and maximum requirement.

- Minimum required data block (access via service channel):
  - The configured operation data is represented in the data container in hexadecimal, without the units.
    - Attribute: Data type and display format' are set hexadecimal (bits 22-20 = 011)
    - Units: Not present
- Maximum required data block (access via service channel):
  - The configured operation data is represented in the data container not with the data block of the data container itself, rather the configured operation data's data block. In this case the operation data will be displayed with the IDN of the data container exactly the same as it would be with its own IDN.

A.3.40 IDN S-0-0457 MDT data container A9

A.3.40.1 Attributes

Table A.55 shows the possible attributes for this IDN.

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Table A.55 – Attributes for IDN S-0-0457

Attribute	Value
Name	MDT data container A9
Version	—
Length	4
Display Format	Hexadecimal
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.40.2 Description

For the extended data container function in the MDT,

- eight data containers (4 octets long, A1 to A8) and
- two data containers (8 octets long, A9 and A10)

are defined, serving as placeholders in the MDT. The contents of the data containers can be dynamically changed by the master as necessary. Additionally, the data container A pointer (S-0-0368) is required for the containers A1 to A10 (S-0-0360, S-0-0450 to S-0-0458), as well as a configuration list (S-0-0370, S-0-0490 to S-0-0498) for each of the MDT container. If the configured operation data is only 2 or 4 octets long, it is placed in the lower part of the MDT data container. The higher part is not used.

In configuring data container operation data, the slave can select between a minimum requirement and maximum requirement.

- Minimum required data block (access via service channel):
  - The configured operation data is represented in the data container in hexadecimal, without the units.
    - Attribute: Data type and display format’ are set hexadecimal (bits 22-20 = 011)
    - Units: Not present
- Maximum required data block (access via service channel):
  - The configured operation data is represented in the data container not with the data block of the data container itself, rather the configured operation data’s data block. In this case the operation data will be displayed with the IDN of the data container exactly the same as it would be with its own IDN.

A.3.41 IDN S-0-0458 MDT data container A10

A.3.41.1 Attributes

Table A.56 shows the possible attributes for this IDN.

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Table A.56 – Attributes for IDN S-0-0458

Attribute	Value
Name	MDT data container A10
Version	—
Length	4
Display Format	Hexadecimal
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.41.2 Description

For the extended data container function in the MDT,

- eight data containers (4 octets long, A1 to A8) and
- two data containers (8 octets long, A9 and A10)

are defined, serving as placeholders in the MDT. The contents of the data containers can be dynamically changed by the master as necessary. Additionally, the data container A pointer (S-0-0368) is required for the containers A1 to A10 (S-0-0360, S-0-0450 to S-0-0458), as well as a configuration list (S-0-0370, S-0-0490 to S-0-0498) for each of the MDT container. If the configured operation data is only 2 or 4 octets long, it is placed in the lower part of the MDT data container. The higher part is not used.

In configuring data container operation data, the slave can select between a minimum requirement and maximum requirement.

- Minimum required data block (access via service channel):
  - The configured operation data is represented in the data container in hexadecimal, without the units.
    - Attribute: Data type and display format' are set hexadecimal (bits 22-20 = 011)
    - Units: Not present
- Maximum required data block (access via service channel):
  - The configured operation data is represented in the data container not with the data block of the data container itself, rather the configured operation data's data block. In this case the operation data will be displayed with the IDN of the data container exactly the same as it would be with its own IDN.

A.3.42 IDN S-0-0459 MDT data container B2

A.3.42.1 Attributes

Table A.57 shows the possible attributes for this IDN.

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Table A.57 – Attributes for IDN S-0-0459

Attribute	Value
Name	MDT data container B2
Version	—
Length	4
Display Format	Hexadecimal
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.42.2 Description

For the extended data container function in the MDT,

- eight data containers (4 octets long, A1 to A8) and
- two data containers (8 octets long, A9 and A10)

are defined, serving as placeholders in the MDT. The contents of the data containers can be dynamically changed by the master as necessary. Additionally, the data container A pointer (S-0-0368) is required for the containers A1 to A10 (S-0-0360, S-0-0450 to S-0-0458), as well as a configuration list (S-0-0370, S-0-0490 to S-0-0498) for each of the MDT container. If the configured operation data is only 2 or 4 octets long, it is placed in the lower part of the MDT data container. The higher part is not used.

In configuring data container operation data, the slave can select between a minimum requirement and maximum requirement.

- Minimum required data block (access via service channel):
  - The configured operation data is represented in the data container in hexadecimal, without the units.
    - Attribute: Data type and display format' are set hexadecimal (bits 22-20 = 011)
    - Units: Not present
- Maximum required data block (access via service channel):
  - The configured operation data is represented in the data container not with the data block of the data container itself, rather the configured operation data's data block. In this case the operation data will be displayed with the IDN of the data container exactly the same as it would be with its own IDN.

A.3.43 IDN S-0-0480 AT data container A2

A.3.43.1 Attributes

Table A.58 shows the possible attributes for this IDN.

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Table A.58 – Attributes for IDN S-0-0480

Attribute	Value
Name	AT data container A2
Version	—
Length	4
Display Format	Hexadecimal
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.43.2 Description

For the standard data container function in the AT

- two data containers (4 octets long, A1 and B1) and
- two data containers (8 octets long, A9 and B2)

are defined, serving as placeholders in the AT. The contents of the data containers can be dynamically changed by the master as necessary. Additionally, the data container A pointer (S-0-0368) is required for the containers A1 and A9 (S-0-0364 and S-0-0487). The data container B pointer (S-0-0369) is required for the containers B1 and B2 (S-0-0365 and S-0-0489) as well as one configuration list (S-0-0371) for all AT container. If the configured operation data is only 2 or 4 octets long, it is placed in the lower part of the AT data container. The higher part is not used.

In configuring data container operation data, the slave can select between a minimum requirement and maximum requirement.

- Minimum required data block (access via service channel):
  - The configured operation data is represented in the data container in hexadecimal, without the units.
    - Attribute: Data type and display format' are set hexadecimal (bits 22-20 = 011)
    - Units: Not present
- Maximum required data block (access via service channel):
  - The configured operation data is represented in the data container not with the data block of the data container itself, rather the configured operation data's data block. In this case the operation data will be displayed with the IDN of the data container exactly the same as it would be with its own IDN.

NOTE The AT data container A1 (S-0-0364) and A9 (S-0-0487) are used also in the extended data container function.

A.3.44 IDN S-0-0481 AT data container A3

A.3.44.1 Attributes

Table A.59 shows the possible attributes for this IDN.

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Table A.59 – Attributes for IDN S-0-0481

Attribute	Value
Name	AT data container A3
Version	—
Length	4
Display Format	Hexadecimal
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.44.2 Description

For the standard data container function in the AT

- two data containers (4 octets long, A1 and B1) and
- two data containers (8 octets long, A9 and B2)

are defined, serving as placeholders in the AT. The contents of the data containers can be dynamically changed by the master as necessary. Additionally, the data container A pointer (S-0-0368) is required for the containers A1 and A9 (S-0-0364 and S-0-0487). The data container B pointer (S-0-0369) is required for the containers B1 and B2 (S-0-0365 and S-0-0489) as well as one configuration list (S-0-0371) for all AT container. If the configured operation data is only 2 or 4 octets long, it is placed in the lower part of the AT data container. The higher part is not used.

In configuring data container operation data, the slave can select between a minimum requirement and maximum requirement.

- Minimum required data block (access via service channel):
  – The configured operation data is represented in the data container in hexadecimal, without the units.
    - Attribute: Data type and display format' are set hexadecimal (bits 22-20 = 011)
    - Units: Not present
- Maximum required data block (access via service channel):
  – The configured operation data is represented in the data container not with the data block of the data container itself, rather the configured operation data's data block. In this case the operation data will be displayed with the IDN of the data container exactly the same as it would be with its own IDN.

NOTE The AT data container A1 (S-0-0364) and A9 (S-0-0487) are used also in the extended data container function.

A.3.45 IDN S-0-0482 AT data container A4

A.3.45.1 Attributes

Table A.60 shows the possible attributes for this IDN.

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Table A.60 – Attributes for IDN S-0-0482

Attribute	Value
Name	AT data container A4
Version	—
Length	4
Display Format	Hexadecimal
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.45.2 Description

For the standard data container function in the AT

- two data containers (4 octets long, A1 and B1) and
- two data containers (8 octets long, A9 and B2)

are defined, serving as placeholders in the AT. The contents of the data containers can be dynamically changed by the master as necessary. Additionally, the data container A pointer (S-0-0368) is required for the containers A1 and A9 (S-0-0364 and S-0-0487). The data container B pointer (S-0-0369) is required for the containers B1 and B2 (S-0-0365 and S-0-0489) as well as one configuration list (S-0-0371) for all AT container. If the configured operation data is only 2 or 4 octets long, it is placed in the lower part of the AT data container. The higher part is not used.

In configuring data container operation data, the slave can select between a minimum requirement and maximum requirement.

- Minimum required data block (access via service channel):
  - The configured operation data is represented in the data container in hexadecimal, without the units.
    - Attribute: Data type and display format' are set hexadecimal (bits 22-20 = 011)
    - Units: Not present
- Maximum required data block (access via service channel):
  - The configured operation data is represented in the data container not with the data block of the data container itself, rather the configured operation data's data block. In this case the operation data will be displayed with the IDN of the data container exactly the same as it would be with its own IDN.

NOTE The AT data container A1 (S-0-0364) and A9 (S-0-0487) are used also in the extended data container function.

A.3.46 IDN S-0-0483 AT data container A5

A.3.46.1 Attributes

Table A.61 shows the possible attributes for this IDN.

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Table A.61 – Attributes for IDN S-0-0483

Attribute	Value
Name	AT data container A5
Version	—
Length	4
Display Format	Hexadecimal
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.46.2 Description

For the standard data container function in the AT

- two data containers (4 octets long, A1 and B1) and
- two data containers (8 octets long, A9 and B2)

are defined, serving as placeholders in the AT. The contents of the data containers can be dynamically changed by the master as necessary. Additionally, the data container A pointer (S-0-0368) is required for the containers A1 and A9 (S-0-0364 and S-0-0487). The data container B pointer (S-0-0369) is required for the containers B1 and B2 (S-0-0365 and S-0-0489) as well as one configuration list (S-0-0371) for all AT container. If the configured operation data is only 2 or 4 octets long, it is placed in the lower part of the AT data container. The higher part is not used.

In configuring data container operation data, the slave can select between a minimum requirement and maximum requirement.

- Minimum required data block (access via service channel):
  – The configured operation data is represented in the data container in hexadecimal, without the units.
    - Attribute: Data type and display format' are set hexadecimal (bits 22-20 = 011)
    - Units: Not present
- Maximum required data block (access via service channel):
  – The configured operation data is represented in the data container not with the data block of the data container itself, rather the configured operation data's data block. In this case the operation data will be displayed with the IDN of the data container exactly the same as it would be with its own IDN.

NOTE The AT data container A1 (S-0-0364) and A9 (S-0-0487) are used also in the extended data container function.

A.3.47 IDN S-0-0484 AT data container A6

A.3.47.1 Attributes

Table A.62 shows the possible attributes for this IDN.

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Table A.62 – Attributes for IDN S-0-0484

Attribute	Value
Name	AT data container A6
Version	—
Length	4
Display Format	Hexadecimal
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.47.2 Description

For the standard data container function in the AT

- two data containers (4 octets long, A1 and B1) and
- two data containers (8 octets long, A9 and B2)

are defined, serving as placeholders in the AT. The contents of the data containers can be dynamically changed by the master as necessary. Additionally, the data container A pointer (S-0-0368) is required for the containers A1 and A9 (S-0-0364 and S-0-0487). The data container B pointer (S-0-0369) is required for the containers B1 and B2 (S-0-0365 and S-0-0489) as well as one configuration list (S-0-0371) for all AT container. If the configured operation data is only 2 or 4 octets long, it is placed in the lower part of the AT data container. The higher part is not used.

In configuring data container operation data, the slave can select between a minimum requirement and maximum requirement.

- Minimum required data block (access via service channel):
  - The configured operation data is represented in the data container in hexadecimal, without the units.
    - Attribute: Data type and display format' are set hexadecimal (bits 22-20 = 011)
    - Units: Not present
- Maximum required data block (access via service channel):
  - The configured operation data is represented in the data container not with the data block of the data container itself, rather the configured operation data's data block. In this case the operation data will be displayed with the IDN of the data container exactly the same as it would be with its own IDN.

NOTE The AT data container A1 (S-0-0364) and A9 (S-0-0487) are used also in the extended data container function.

A.3.48 IDN S-0-0485 AT data container A7

A.3.48.1 Attributes

Table A.63 shows the possible attributes for this IDN.

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Table A.63 – Attributes for IDN S-0-0485

Attribute	Value
Name	AT data container A7
Version	—
Length	4
Display Format	Hexadecimal
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.48.2 Description

For the standard data container function in the AT

- two data containers (4 octets long, A1 and B1) and
- two data containers (8 octets long, A9 and B2)

are defined, serving as placeholders in the AT. The contents of the data containers can be dynamically changed by the master as necessary. Additionally, the data container A pointer (S-0-0368) is required for the containers A1 and A9 (S-0-0364 and S-0-0487). The data container B pointer (S-0-0369) is required for the containers B1 and B2 (S-0-0365 and S-0-0489) as well as one configuration list (S-0-0371) for all AT container. If the configured operation data is only 2 or 4 octets long, it is placed in the lower part of the AT data container. The higher part is not used.

In configuring data container operation data, the slave can select between a minimum requirement and maximum requirement.

- Minimum required data block (access via service channel):
  - The configured operation data is represented in the data container in hexadecimal, without the units.
    - Attribute: Data type and display format' are set hexadecimal (bits 22-20 = 011)
    - Units: Not present
- Maximum required data block (access via service channel):
  - The configured operation data is represented in the data container not with the data block of the data container itself, rather the configured operation data's data block. In this case the operation data will be displayed with the IDN of the data container exactly the same as it would be with its own IDN.

NOTE The AT data container A1 (S-0-0364) and A9 (S-0-0487) are used also in the extended data container function.

A.3.49 IDN S-0-0486 AT data container A8

A.3.49.1 Attributes

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Table A.64 – Attributes for IDN S-0-0486

Attribute	Value
Name	AT data container A8
Version	—
Length	4
Display Format	Hexadecimal
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.49.2 Description

For the standard data container function in the AT

- two data containers (4 octets long, A1 and B1) and
- two data containers (8 octets long, A9 and B2)

are defined, serving as placeholders in the AT. The contents of the data containers can be dynamically changed by the master as necessary. Additionally, the data container A pointer (S-0-0368) is required for the containers A1 and A9 (S-0-0364 and S-0-0487). The data container B pointer (S-0-0369) is required for the containers B1 and B2 (S-0-0365 and S-0-0489) as well as one configuration list (S-0-0371) for all AT container. If the configured operation data is only 2 or 4 octets long, it is placed in the lower part of the AT data container. The higher part is not used.

In configuring data container operation data, the slave can select between a minimum requirement and maximum requirement.

- Minimum required data block (access via service channel):
  - The configured operation data is represented in the data container in hexadecimal, without the units.
    - Attribute: Data type and display format' are set hexadecimal (bits 22-20 = 011)
    - Units: Not present
- Maximum required data block (access via service channel):
  - The configured operation data is represented in the data container not with the data block of the data container itself, rather the configured operation data's data block. In this case the operation data will be displayed with the IDN of the data container exactly the same as it would be with its own IDN.

NOTE The AT data container A1 (S-0-0364) and A9 (S-0-0487) are used also in the extended data container function.

A.3.50 IDN S-0-0487 AT data container A9

A.3.50.1 Attributes

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Table A.65 – Attributes for IDN S-0-0487

Attribute	Value
Name	AT data container A9
Version	—
Length	4
Display Format	Hexadecimal
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.50.2 Description

For the standard data container function in the AT

- two data containers (4 octets long, A1 and B1) and
- two data containers (8 octets long, A9 and B2)

are defined, serving as placeholders in the AT. The contents of the data containers can be dynamically changed by the master as necessary. Additionally, the data container A pointer (S-0-0368) is required for the containers A1 and A9 (S-0-0364 and S-0-0487). The data container B pointer (S-0-0369) is required for the containers B1 and B2 (S-0-0365 and S-0-0489) as well as one configuration list (S-0-0371) for all AT container. If the configured operation data is only 2 or 4 octets long, it is placed in the lower part of the AT data container. The higher part is not used.

In configuring data container operation data, the slave can select between a minimum requirement and maximum requirement.

- Minimum required data block (access via service channel):
  - The configured operation data is represented in the data container in hexadecimal, without the units.
    - Attribute: Data type and display format' are set hexadecimal (bits 22-20 = 011)
    - Units: Not present
- Maximum required data block (access via service channel):
  - The configured operation data is represented in the data container not with the data block of the data container itself, rather the configured operation data's data block. In this case the operation data will be displayed with the IDN of the data container exactly the same as it would be with its own IDN.

NOTE The AT data container A1 (S-0-0364) and A9 (S-0-0487) are used also in the extended data container function.

A.3.51 IDN S-0-0488 AT data container A10

A.3.51.1 Attributes

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Table A.66 – Attributes for IDN S-0-0488

Attribute	Value
Name	AT data container A10
Version	—
Length	4
Display Format	Hexadecimal
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.51.2 Description

For the standard data container function in the AT

- two data containers (4 octets long, A1 and B1) and
- two data containers (8 octets long, A9 and B2)

are defined, serving as placeholders in the AT. The contents of the data containers can be dynamically changed by the master as necessary. Additionally, the data container A pointer (S-0-0368) is required for the containers A1 and A9 (S-0-0364 and S-0-0487). The data container B pointer (S-0-0369) is required for the containers B1 and B2 (S-0-0365 and S-0-0489) as well as one configuration list (S-0-0371) for all AT container. If the configured operation data is only 2 or 4 octets long, it is placed in the lower part of the AT data container. The higher part is not used.

In configuring data container operation data, the slave can select between a minimum requirement and maximum requirement.

- Minimum required data block (access via service channel):
  - The configured operation data is represented in the data container in hexadecimal, without the units.
    - Attribute: Data type and display format' are set hexadecimal (bits 22-20 = 011)
    - Units: Not present
- Maximum required data block (access via service channel):
  - The configured operation data is represented in the data container not with the data block of the data container itself, rather the configured operation data's data block. In this case the operation data will be displayed with the IDN of the data container exactly the same as it would be with its own IDN.

NOTE The AT data container A1 (S-0-0364) and A9 (S-0-0487) are used also in the extended data container function.

A.3.52 IDN S-0-0489 AT data container B

A.3.52.1 Attributes

Table A.67 shows the possible attributes for this IDN.

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Table A.67 – Attributes for IDN S-0-0489

Attribute	Value
Name	AT data container B
Version	—
Length	4
Display Format	Hexadecimal
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.52.2 Description

For the standard data container function in the AT

- two data containers (4 octets long, A1 and B1) and
- two data containers (8 octets long, A9 and B2)

are defined, serving as placeholders in the AT. The contents of the data containers can be dynamically changed by the master as necessary. Additionally, the data container A pointer (S-0-0368) is required for the containers A1 and A9 (S-0-0364 and S-0-0487). The data container B pointer (S-0-0369) is required for the containers B1 and B2 (S-0-0365 and S-0-0489) as well as one configuration list (S-0-0371) for all AT container. If the configured operation data is only 2 or 4 octets long, it is placed in the lower part of the AT data container. The higher part is not used.

In configuring data container operation data, the slave can select between a minimum requirement and maximum requirement.

- Minimum required data block (access via service channel):
  - The configured operation data is represented in the data container in hexadecimal, without the units.
    - Attribute: Data type and display format' are set hexadecimal (bits 22-20 = 011)
    - Units: Not present
- Maximum required data block (access via service channel):
  - The configured operation data is represented in the data container not with the data block of the data container itself, rather the configured operation data's data block. In this case the operation data will be displayed with the IDN of the data container exactly the same as it would be with its own IDN.

NOTE The AT data container A1 (S-0-0364) and A9 (S-0-0487) are used also in the extended data container function.

A.3.53 IDN S-0-0490 MDT data container A2 configuration list

A.3.53.1 Attributes

Table A.68 shows the possible attributes for this IDN.

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Table A.68 – Attributes for IDN S-0-0490

Attribute	Value
Name	MDT data container A2 configuration list
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.53.2 Description

The Master enters into the MDT data container configuration list the IDN numbers for the operation data that are to be sent via the corresponding MDT data containers (A and B of standard data container, and A1 to A10 of extended data container) as needed from the master to the slave.

The IDNs in this IDN list may be taken from S-0-0445 IDN-list of configurable data in the MDT data container or from S-0-0188 IDN-list of configurable data as consumer, if S-0-0445 does not exist.

A.3.54 IDN S-0-0491 MDT data container A3 configuration list

A.3.54.1 Attributes

Table A.69 shows the possible attributes for this IDN.

Table A.69 – Attributes for IDN S-0-0491

Attribute	Value
Name	MDT data container A3 configuration list
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.54.2 Description

The Master enters into the MDT data container configuration list the IDN numbers for the operation data that are to be sent via the corresponding MDT data containers (A and B of

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standard data container, and A1 to A10 of extended data container) as needed from the master to the slave.

The IDNs in this IDN list may be taken from S-0-0445 IDN-list of configurable data in the MDT data container or from S-0-0188 IDN-list of configurable data as consumer, if S-0-0445 does not exist.

A.3.55 IDN S-0-0492 MDT data container A4 configuration list

A.3.55.1 Attributes

Table A.70 shows the possible attributes for this IDN.

Table A.70 – Attributes for IDN S-0-0492

Attribute	Value
Name	MDT data container A4 configuration list
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.55.2 Description

The Master enters into the MDT data container configuration list the IDN numbers for the operation data that are to be sent via the corresponding MDT data containers (A and B of standard data container, and A1 to A10 of extended data container) as needed from the master to the slave.

The IDNs in this IDN list may be taken from S-0-0445 IDN-list of configurable data in the MDT data container or from S-0-0188 IDN-list of configurable data as consumer, if S-0-0445 does not exist.

A.3.56 IDN S-0-0493 MDT data container A5 configuration list

A.3.56.1 Attributes

Table A.71 shows the possible attributes for this IDN.

Table A.71 – Attributes for IDN S-0-0493

Attribute	Value
Name	MDT data container A5 configuration list
Version	—
Length	4, variable
Display Format	IDN
Min input value	—

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Attribute	Value
Max input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.56.2 Description

The Master enters into the MDT data container configuration list the IDN numbers for the operation data that are to be sent via the corresponding MDT data containers (A and B of standard data container, and A1 to A10 of extended data container) as needed from the master to the slave.

The IDNs in this IDN list may be taken from S-0-0445 IDN-list of configurable data in the MDT data container or from S-0-0188 IDN-list of configurable data as consumer, if S-0-0445 does not exist.

A.3.57 IDN S-0-0494 MDT data container A6 configuration list

A.3.57.1 Attributes

Table A.72 shows the possible attributes for this IDN.

Table A.72 – Attributes for IDN S-0-0494

Attribute	Value
Name	MDT data container A6 configuration list
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.57.2 Description

The Master enters into the MDT data container configuration list the IDN numbers for the operation data that are to be sent via the corresponding MDT data containers (A and B of standard data container, and A1 to A10 of extended data container) as needed from the master to the slave.

The IDNs in this IDN list may be taken from S-0-0445 IDN-list of configurable data in the MDT data container or from S-0-0188 IDN-list of configurable data as consumer, if S-0-0445 does not exist.

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A.3.58 IDN S-0-0495 MDT data container A7 configuration list

A.3.58.1 Attributes

Table A.73 shows the possible attributes for this IDN.

Table A.73 – Attributes for IDN S-0-0495

Attribute	Value
Name	MDT data container A7 configuration list
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.58.2 Description

The Master enters into the MDT data container configuration list the IDN numbers for the operation data that are to be sent via the corresponding MDT data containers (A and B of standard data container, and A1 to A10 of extended data container) as needed from the master to the slave.

The IDNs in this IDN list may be taken from S-0-0445 IDN-list of configurable data in the MDT data container or from S-0-0188 IDN-list of configurable data as consumer, if S-0-0445 does not exist.

A.3.59 IDN S-0-0496 MDT data container A8 configuration list

A.3.59.1 Attributes

Table A.74 shows the possible attributes for this IDN.

Table A.74 – Attributes for IDN S-0-0496

Attribute	Value
Name	MDT data container A8 configuration list
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1

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Attribute	Value
Unit	—

A.3.59.2 Description

The Master enters into the MDT data container configuration list the IDN numbers for the operation data that are to be sent via the corresponding MDT data containers (A and B of standard data container, and A1 to A10 of extended data container) as needed from the master to the slave.

The IDNs in this IDN list may be taken from S-0-0445 IDN-list of configurable data in the MDT data container or from S-0-0188 IDN-list of configurable data as consumer, if S-0-0445 does not exist.

A.3.60 IDN S-0-0497 MDT data container A9 configuration list

A.3.60.1 Attributes

Table A.75 shows the possible attributes for this IDN.

Table A.75 – Attributes for IDN S-0-0497

Attribute	Value
Name	MDT data container A9 configuration list
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.60.2 Description

The Master enters into the MDT data container configuration list the IDN numbers for the operation data that are to be sent via the corresponding MDT data containers (A and B of standard data container, and A1 to A10 of extended data container) as needed from the master to the slave.

The IDNs in this IDN list may be taken from S-0-0445 IDN-list of configurable data in the MDT data container or from S-0-0188 IDN-list of configurable data as consumer, if S-0-0445 does not exist.

A.3.61 IDN S-0-0498 MDT data container A10 configuration list

A.3.61.1 Attributes

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Table A.76 – Attributes for IDN S-0-0498

Attribute	Value
Name	MDT data container A10 configuration list
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.61.2 Description

The Master enters into the MDT data container configuration list the IDN numbers for the operation data that are to be sent via the corresponding MDT data containers (A and B of standard data container, and A1 to A10 of extended data container) as needed from the master to the slave.

The IDNs in this IDN list may be taken from S-0-0445 IDN-list of configurable data in the MDT data container or from S-0-0188 IDN-list of configurable data as consumer, if S-0-0445 does not exist.

A.3.62 IDN S-0-0500 AT data container A2 configuration list

A.3.62.1 Attributes

Table A.77 shows the possible attributes for this IDN.

Table A.77 – Attributes for IDN S-0-0500

Attribute	Value
Name	AT data container A2 configuration list
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.62.2 Description

The Master enters into the AT data container configuration list the IDN numbers for the operation data that are to be sent via the corresponding AT data containers (A and B of

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standard data container, and A1 to A10 of extended data container) as needed from the slave to the master.

The IDNs in this IDN list may be taken from S-0-0444 or from S-0-0187, if S-0-0444 does not exist.

A.3.63 IDN S-0-0501 AT data container A3 configuration list

A.3.63.1 Attributes

Table A.78 shows the possible attributes for this IDN.

Table A.78 – Attributes for IDN S-0-0501

Attribute	Value
Name	AT data container A3 configuration list
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.63.2 Description

The Master enters into the AT data container configuration list the IDN numbers for the operation data that are to be sent via the corresponding AT data containers (A and B of standard data container, and A1 to A10 of extended data container) as needed from the slave to the master.

The IDNs in this IDN list may be taken from S-0-0444 or from S-0-0187, if S-0-0444 does not exist.

A.3.64 IDN S-0-0502 AT data container A4 configuration list

A.3.64.1 Attributes

Table A.79 shows the possible attributes for this IDN.

Table A.79 – Attributes for IDN S-0-0502

Attribute	Value
Name	AT data container A4 configuration list
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—

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Attribute	Value
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.64.2 Description

The Master enters into the AT data container configuration list the IDN numbers for the operation data that are to be sent via the corresponding AT data containers (A and B of standard data container, and A1 to A10 of extended data container) as needed from the slave to the master.

The IDNs in this IDN list may be taken from S-0-0444 or from S-0-0187, if S-0-0444 does not exist.

A.3.65 IDN S-0-0503 AT data container A5 configuration list

A.3.65.1 Attributes

Table A.80 shows the possible attributes for this IDN.

Table A.80 – Attributes for IDN S-0-0503

Attribute	Value
Name	AT data container A5 configuration list
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.65.2 Description

The Master enters into the AT data container configuration list the IDN numbers for the operation data that are to be sent via the corresponding AT data containers (A and B of standard data container, and A1 to A10 of extended data container) as needed from the slave to the master.

The IDNs in this IDN list may be taken from S-0-0444 or from S-0-0187, if S-0-0444 does not exist.

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A.3.66 IDN S-0-0504 AT data container A6 configuration list

A.3.66.1 Attributes

Table A.81 shows the possible attributes for this IDN.

Table A.81 – Attributes for IDN S-0-0504

Attribute	Value
Name	AT data container A6 configuration list
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.66.2 Description

The Master enters into the AT data container configuration list the IDN numbers for the operation data that are to be sent via the corresponding AT data containers (A and B of standard data container, and A1 to A10 of extended data container) as needed from the slave to the master.

The IDNs in this IDN list may be taken from S-0-0444 or from S-0-0187, if S-0-0444 does not exist.

A.3.67 IDN S-0-0505 AT data container A7 configuration list

A.3.67.1 Attributes

Table A.82 shows the possible attributes for this IDN.

Table A.82 – Attributes for IDN S-0-0505

Attribute	Value
Name	AT data container A7 configuration list
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

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A.3.67.2 Description

The Master enters into the AT data container configuration list the IDN numbers for the operation data that are to be sent via the corresponding AT data containers (A and B of standard data container, and A1 to A10 of extended data container) as needed from the slave to the master.

The IDNs in this IDN list may be taken from S-0-0444 or from S-0-0187, if S-0-0444 does not exist.

A.3.68 IDN S-0-0506 AT data container A8 configuration list

A.3.68.1 Attributes

Table A.83 shows the possible attributes for this IDN.

Table A.83 – Attributes for IDN S-0-0506

Attribute	Value
Name	AT data container A8 configuration list
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.68.2 Description

The Master enters into the AT data container configuration list the IDN numbers for the operation data that are to be sent via the corresponding AT data containers (A and B of standard data container, and A1 to A10 of extended data container) as needed from the slave to the master.

The IDNs in this IDN list may be taken from S-0-0444 or from S-0-0187, if S-0-0444 does not exist.

A.3.69 IDN S-0-0507 AT data container A9 configuration list

A.3.69.1 Attributes

Table A.84 shows the possible attributes for this IDN.

Table A.84 – Attributes for IDN S-0-0507

Attribute	Value
Name	AT data container A9 configuration list
Version	—
Length	4, variable

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Attribute	Value
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.69.2 Description

The Master enters into the AT data container configuration list the IDN numbers for the operation data that are to be sent via the corresponding AT data containers (A and B of standard data container, and A1 to A10 of extended data container) as needed from the slave to the master.

The IDNs in this IDN list may be taken from S-0-0444 or from S-0-0187, if S-0-0444 does not exist.

A.3.70 IDN S-0-0508 AT data container A10 configuration list

A.3.70.1 Attributes

Table A.85 shows the possible attributes for this IDN.

Table A.85 – Attributes for IDN S-0-0508

Attribute	Value
Name	AT data container A10 configuration list
Version	—
Length	4, variable
Display Format	IDN
Min input value	—
Max input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.70.2 Description

The Master enters into the AT data container configuration list the IDN numbers for the operation data that are to be sent via the corresponding AT data containers (A and B of standard data container, and A1 to A10 of extended data container) as needed from the slave to the master.

The IDNs in this IDN list may be taken from S-0-0444 or from S-0-0187, if S-0-0444 does not exist.

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A.3.71 IDN S-0-1000.0.1 Active SCP Classes

A.3.71.1 Attributes

Table A.86 shows the possible attributes for this IDN.

Table A.86 – Attributes of IDN S-0-1000.0.1

Attribute	Value
Name	Active SCP Classes
Version	—
Length	2, variable
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.71.2 Description

The Master programs the parameter IDN S-0-1000.0.1 with the classes of IDN S-0-1000.0.0 that the slave knows which classes are needed for the application. This parameter can only contain classes, which are also offered in IDN S-0-1000.0.0 by the slave. Each class shall be unique in IDN S-0-1000.0.1. This parameter is writable in CP2 only. Therefore, the slave can make a resource optimization of the communication functions in CP3.

A.3.72 IDN S-0-1000 SCP Type & Version

A.3.72.1 Attributes

Table A.87 shows the possible attributes for this IDN.

Table A.87 – Attributes of IDN S-0-1000

Attribute	Value
Name	SCP Type & Version
Version	—
Length	2, variable
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

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A.3.72.2 Description

The SCP Type & Version (see Table A.88) contains a list of all Type 19 communication classes with the dedicated version supported by the slave. The support of a class version implies automatically the support of all lower versions of this class too. Nevertheless, a slave shall signal all versions of implemented classes as separate elements. The order of elements in this list is not defined.

The bits 15 … 8 indicate the SCP class which is available in the slave device, bits 7 … 4 are reserved, bits 3 … 0 indicate the version of the SCP class.

Table A.88 – SCP type and version

Class code Bits 15-8	Reserved Bits 7-4	Version Bits 3-0	Class name	Defined in Type 19 version	Description
0x01	0x0	0x1	SCP_FixCFG	V1.1.1	Fix configuration of connections
0x01	0x0	0x2	SCP_FixCFG_0x02	V1.3	Fix configuration of connections
0x01	0x0	0x3	SCP_FixCFG_0x03	V1.3	Fix configuration of connections & connection stop
0x02	0x0	0x1	SCP_VarCFG	V1.1.1	Variable configuration of homogeneous connections
0x02	0x0	0x2	SCP_VarCFG_0x02	V1.3	Variable configuration of homogeneous connections
0x02	0x0	0x3	SCP_VarCFG_0x03	V1.3	Variable configuration of homogeneous connections & connection stop
0x03	0x0	0x1	SCP_Sync	V1.1.1	Synchronization
0x03	0x0	0x2	SCP_Sync_0x02	V1.3	Synchronization tSync > tScyc using MDT Extended field
0x03	0x0	0x3	SCP_Sync_0x03	V1.3	Synchronization tSync > tScyc using MDT Extended field
0x04	0x0	0x1	SCP_WD	V1.1.1	Watch dog of connection
0x04	0x0	0x2	SCP_WD_0x02	V1.3	Watchdog of connection with timeout & data losses
0x05	0x0	0x1	SCP_Diag	V1.1.1	Communication diagnoses
0x06	0x0	0x1	SCP_RTB	V1.1.1	Configuration of real-time bits
0x07	0x0	0x1	SCP_HP	V1.1.1	Hot-plug
0x08	0x0	0x1	SCP_SMP	V1.1.1	SMP
0x09	0x0	0x1	SCP_MuX	V1.1.1	Multiplex channel (standard data container)
0x0A	0x0	0x1	SCP_NRT	V1.1.1	-
0x0B	0x0	0x1	SCP_SIG	V1.1.1	Word of real-time bits as producer and consumer
0x0C	0x0	0x1	SCP_ListSeg	V1.3	segmented list transfer via the SVC
0x0D	0x0	0x1	SCP_IPS	V1.3	Support of IPS internet protocol services using the UC channel
0x0E	0xn	0xn	reserved		for future extensions
0x0F	0x0	0x1	SCP_Cap	V1.3	Connection Capabilities

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Class code Bits 15-8	Reserved Bits 7-4	Version Bits 3-0	Class name	Defined in Type 19 version	Description
0x10	0x0	0x1	SCP_ExtMuX	V1.1.2	Extended Multiplex channel (extended data container)
0x11	0x0	0x1	SCP_RTBListProd	V1.3	List of real-time bits as producer (status)
0x12	0x0	0x1	SCP_RTBListCons	V1.3	List of real-time bits as consumer (control)
0x13	0x0	0x1	SCP_SysTime	V1.3	set Type 19 Time using MDT Extended field
0x14	0x0	0x1	SCP_RTBWordProd	V1.3	Word of real-time bits as producer
0x15	0x0	0x1	SCP_RTBWordCons	V1.3	Word of real-time bits as consumer
0x16	0x0	0x1	SCP_SafetyCon	V1.3	CSoS connection
0x17	0x0	0x1	SCP_OvSBasic	V1.3	Word of real-time bits as consumer
0x18	0x0	0x1	SCP_NRTPC	V1.3	UC channel (IP communication)
0x19	0x0	0x1	SCP_Cyc	V1.3	cyclic communication
0x03	0x0	0x1	SCP_Sync	V1.1.1	Synchronization
0x03	0x0	0x2	SCP_Sync_0x02	V1.3	Synchronization tSync > tScyc using MDT Extended field
0x03	0x0	0x3	SCP_Sync_0x03	V1.3	Synchronization tSync > tScyc using MDT Extended field
0x04	0x0	0x1	SCP_WD	V1.1.1	Watch dog of connection
0x04	0x0	0x2	SCP_WD_0x02	V1.3	Watchdog of connection with timeout & data losses
0x05	0x0	0x1	SCP_Diag	V1.1.1	Communication diagnoses
0x06	0x0	0x1	SCP_RTB	V1.1.1	Configuration of real-time bits
0x07	0x0	0x1	SCP_HP	V1.1.1	Hot-plug
0x08	0x0	0x1	SCP_SMP	V1.1.1	SMP
0x09	0x0	0x1	SCP_MuX	V1.1.1	Multiplex channel (standard data container)
0x0A	0x0	0x1	SCP_NRT	V1.1.1	-
0x0B	0x0	0x1	SCP_SIG	V1.1.1	Word of real-time bits as producer and consumer
0x0C	0x0	0x1	SCP_ListSeg	V1.3	segmented list transfer via the SVC
0x0D	0x0	0x1	SCP_IPS	V1.3	Support of IPS internet protocol services using the UC channel
0x0E	0xn	0xn	reserved		for future extensions
0x0F	0x0	0x1	SCP_Cap	V1.3	Connection Capabilities
0x10	0x0	0x1	SCP_ExtMuX	V1.1.2	Extended Multiplex channel (extended data container)
0x11	0x0	0x1	SCP_RTBListProd	V1.3	List of real-time bits as producer (status)
0x12	0x0	0x1	SCP_RTBListCons	V1.3	List of real-time bits as consumer (control)
0x13	0x0	0x1	SCP_SysTime	V1.3	set Type 19 Time using MDT

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Class code Bits 15-8	Reserved Bits 7-4	Version Bits 3-0	Class name	Defined in Type 19 version	Description
					Extended field
0x14	0x0	0x1	SCP_RTBWordProd	V1.3	Word of real-time bits as producer
0x15	0x0	0x1	SCP_RTBWordCons	V1.3	Word of real-time bits as consumer
0x16	0x0	0x1	SCP_SafetyCon	V1.3	CSoS connection
0x17	0x0	0x1	SCP_OvSBasic	V1.3	Word of real-time bits as consumer
0x18	0x0	0x1	SCP_NRTPC	V1.3	UC channel (IP communication)
0x19	0x0	0x1	SCP_Cyc	V1.3	cyclic communication

A.3.73 IDN S-0-1002 Communication cycle time

A.3.73.1 Attributes

Table A.89 shows the possible attributes for this IDN.

Table A.89 – Attributes of IDN S-0-1002

Attribute	Value
Name	Communication cycle time (tScyc)
Version	—
Length	4
Display Format	Unsigned decimal
Min. input value	31 250 (31,250 µs)
Max. input value	65 000 000 (65000,000 µs)
Positions after decimal point	3
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	0,001 µs
Unit	µs

A.3.73.2 Description

The communication cycle time (tScyc) defines the intervals during which the configured MDTs and ATs shall be transferred by the master to all present slaves. The communication cycle times are defined as 31,25 µs, 62,5 µs, 125 µs, 250 µs or any integer multiple of 250 µs up to 65 ms. In CP2, tScyc needs to be transferred from the master to the slave and has to be activated by the master and slave in CP3 and CP4.

Min/max values are mandatory and shall be adopted by the manufacturer. The min/max values shall be the values that are theoretically possible.

A.3.74 IDN S-0-1003 Allowed MST losses in CP3/CP4

A.3.74.1 Attributes

Table A.90 shows the possible attributes for this IDN.

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Table A.90 – Attributes of IDN S-0-1003

Attribute	Value
Name	Allowed MST losses in CP3/CP4
Version	—
Length	4
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.74.2 Description

This parameter defines the maximum number of successive communication cycles in which a slave may not receive the MST in CP3 and CP4. The slave shall switch from CP3 or CP4 back to NRT mode if it did not receive its MST within more than this user-defined quantity and

- sets the S-0-0390 Diagnostic number to 0xC30F4001 and
- sets the error (S-DEV.Bit7) in its S-0-1045 Device Status (S-DEV)

Less than 50 % of the operation data of this parameter, the slave shall

- resets the communication warning (S-DEV.Bit15) in its device status and
- resets the warning (S-DEV.Bit6) in its S-0-1045 Device Status (S-DEV)

Reaching more than 50 % of the operation data of this parameter, the slave shall

- sets the S-0-0390 Diagnostic number to 0xC30E4001
- sets the communication warning (S-DEV.Bit15) in its device status and
- flashes the Type 19 LED between red and green at least 2 seconds or as long as the communication warning (S-DEV.Bit15) is present and
- sets the warning (S-DEV.Bit6) in its S-0-1045 Device Status (S-DEV)

Whereas this parameter shall be set to a value that is large enough (compare to S-0-1050.x.11 Allowed Data Losses), so that the master can keep communicating with undisturbed sub-devices for safely stopping the other parts of the machine.

For example:

- S-0-1003 = 5 -> Warning is set with 3 telegram losses. Error is set with 6 telegram losses.
- S-0-1003 = 4 -> Warning is set with 3 telegram losses. Error is set with 5 telegram losses.

A.3.75 IDN S-0-1005 Minimum feedback processing time (t_5)

A.3.75.1 Attributes

Table A.91 shows the possible attributes for this IDN.

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Table A.91 – Attributes of IDN S-0-1005

Attribute	Value
Name	Minimum feedback processing time (t_5)
Version	—
Length	4
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	3
Write protection	Always
Conversion factor	1
Scaling/resolution	0,001 μs
Unit	μs

A.3.75.2 Description

t_5 specifies the slave-specific maximum time duration that it needs between capturing its producer data (for example feedback values) and making them ready for transmission within ATs.

If IDN S-0-1060 (Connection capabilities) are available, t_5 covers the maximum value of IDN S-0-1060.x.07 (Maximum processing time) for all producer instances of IDN S-0-1060.

A.3.76 IDN S-0-1006 AT transmission starting time (t_1)

A.3.76.1 Attributes

Table A.92 shows the possible attributes for this IDN.

Table A.92 – Attributes of IDN S-0-1006

Attribute	Value
Name	AT transmission starting time (t_1)
Version	—
Length	4
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	3
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	0,001 μs
Unit	μs

A.3.76.2 Description

The AT0 transmission starting time (t1) determines the nominal time interval between the end of MST and beginning of AT0. The master sends its AT0 based on the MST in CP3 and CP4. This parameter shall be transferred by the master to the slave during CP2.

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The maximum transmission starting time shall be less than tScyc.

A.3.77 IDN S-0-1007 Synchronization time (Tsync)

A.3.77.1 Attributes

Table A.93 shows the possible attributes for this IDN.

Table A.93 – Attributes for IDN S-0-1007

Attribute	Value
Name	Synchronization time (Tsync)
Version	—
Length	4
Display Format	Unsigned decimal
Min. input value	0
Max. input value	—
Positions after decimal point	3
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	0,001 µs
Unit	0µs

A.3.77.2 Description

The synchronization time (TSync) defines the time at which all producer cycle times (producing and consuming connections) in a slave are synchronized. The master shall set the synchronization time smaller than the synchronization cycle time (tsync-cycle). The synchronization cycle time is the least common multiple of all producer cycle times (tPcyc) which shall be synchronized in a network.

In each communication cycle the synchronization reference point (TSref) is generated by the MSTs. One of these TSref times is selected with TSref-Counter = 0 (TSref0). The synchronization time (Tsync) defines the offset between the time TSref0 and TSync for the synchronization cycle (tsync-cycle).

All producer cycles (tPcyc) in the slave are synchronized at time TSync. The following synchronization times are defined by the corresponding producer cycle times. To distinguish the synchronization times of the connections, they are labeled as T4PCx. That means, synchronization time (T4) of the producer cycle (PC), with the structure index (x) of the connection (x = 0 ... 255).

The sub-device shall enable the synchronization time during CP3.

Figure A.4 shows an example of the synchronization timing with different producer cycles.

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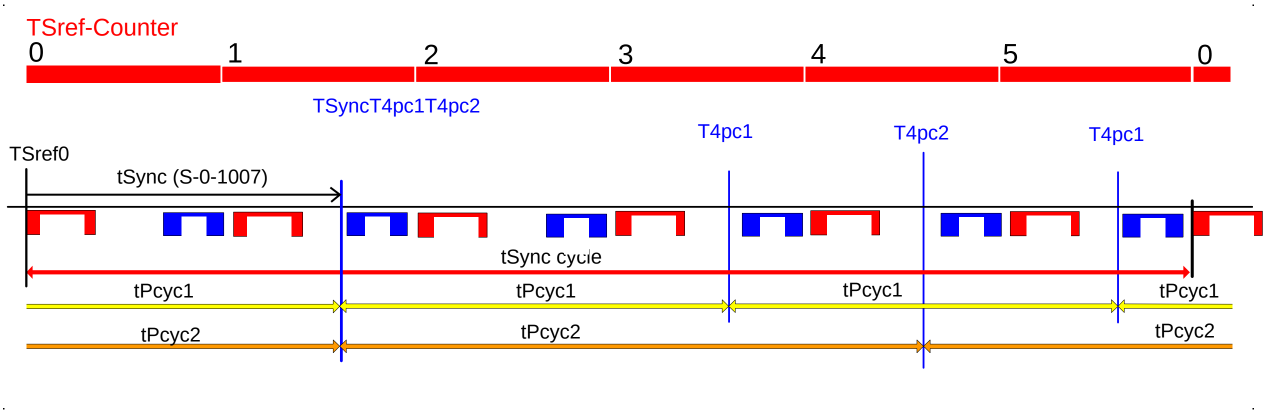

Figure A.4 – Example of synchronization timing with different producer cycles

A.3.78 IDN S-0-1008 Command value valid time (t_3)

A.3.78.1 Attributes

Table A.94 shows the possible attributes for this IDN.

Table A.94 – Attributes for IDN S-0-1008

Attribute	Value
Name	Command value valid time (t_3)
Version	—
Length	4
Display Format	Unsigned decimal
Min. input value	0
Max. input value	tScyc
Positions after decimal point	3
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	0,001 µs
Unit	µs

A.3.78.2 Description

The command value valid time indicates the time after which the slave can access the new values from the MDT related to the synchronization time. Thus the master can preset the same command value valid time for all coordinated applications.

A.3.79 IDN S-0-1009 Device Control (C-DEV) offset in MDT

A.3.79.1 Attributes

Table A.95 shows the possible attributes for this IDN.

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Table A.95 – Attributes of IDN S-0-1009

Attribute	Value
Name	Device Control (C-DEV) offset in MDT
Version	—
Length	2
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.79.2 Description

The device control offset in the MDT defines MDT number and the position within this MDT for the device control. This parameter shall be transferred by the master to each slave during CP2. It shall become active during CP3 in the master and slave. This offset shall start after the Type 19 header within the MDT. The offset of device control shall be an even number.

Table A.96 shows the structure of this IDN.

Table A.96 – C-DEV Offset in MDT

Bit number	Bit value	Description
15-14	00	reserved
13-12	—	MDT-number
	00	MDT0
	01	MDT1
	10	MDT2
	11	MDT3
11-0	—	Offset in MDT (in octets)
	0..1492	C-DEV offset in MDT (shall be an even number)

A.3.80 IDN S-0-1010 Lengths of MDTs

A.3.80.1 Attributes

Table A.97 shows the possible attributes for this IDN.

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Table A.97 – Attributes of IDN S-0-1010

Attribute	Value
Name	Lengths of MDTs
Version	—
Length	2, variable
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.80.2 Description

The lengths of the MDTs shall be an even number and are expressed in octets (see Figure A.5). The parameter shall contain the lengths of the four possible master data telegrams. The lengths are necessary for the initialization of the Type 19 communication hardware. Always all four lengths have to be specified. Not configured MDTs shall be marked with length = 0 and the master shall not transmit these MDTs. Each slave shall be informed by the master during CP2 of the lengths of all configured MDTs. It shall become active in the master and slave during CP3.

The length includes all data between the end of Type 19 header to the beginning of FCS.

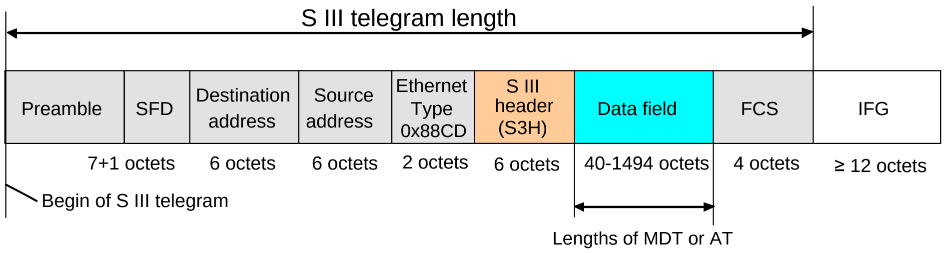

Figure A.5 – Definition of MDT length

The master shall set the lengths of any configured MDT in the range of 40 ≤ MDT length ≤ 1494, otherwise the slave generates the error message 0x7008 in the SVC.

The number of list elements of this parameter is fixed to four.

Figure A.6 shows the structure of this IDN as an example.

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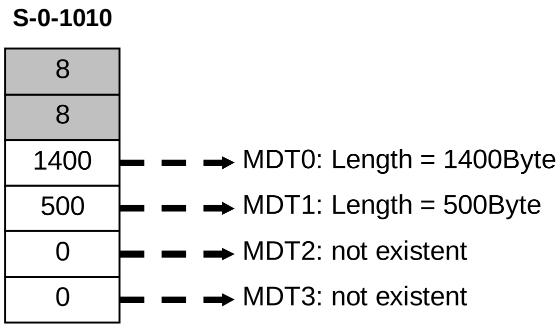

Figure A.6 – Lengths of MDTs (example)

A.3.81 IDN S-0-1011 Device Status (S-DEV) offset in AT

A.3.81.1 Attributes

Table A.98 shows the possible attributes for this IDN.

Table A.98 – Attributes of IDN S-0-1011

Attribute	Value
Name	Device Status (S-DEV) offset in AT
Version	—
Length	2
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.81.2 Description

The device status offset in AT defines the position of device status field of the slave in one of the ATs, expressed as a OCTET position. The offset shall start after the Type 19 header within the AT. This parameter shall be transferred by the master to each slave during CP2. It shall become active during CP3 in the master and slave. The offset of device status shall be an even number.

Table A.99 shows the structure of this IDN.

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Table A.99 – S-DEV Offset in AT

Bit number	Bit value	Description
15-14	—	reserved
13-12	—	AT-number
	00	AT0
	01	AT1
	10	AT2
	11	AT3
11-0	—	S-DEV offset in AT (in octets)
	0..1492	S-DEV offset in AT (shall be an even number)

A.3.82 IDN S-0-1012 Lengths of ATs

A.3.82.1 Attributes

Table A.100 shows the possible attributes for this IDN.

Table A.100 – Attributes of IDN S-0-1012

Attribute	Value
Name	Lengths of ATs
Version	—
Length	2, variable
Display Format	Unsigned decimal
Min input value	—
Max. input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.82.2 Description

The lengths of the ATs shall be an even number and are expressed in octets (see Figure A.7). The parameter shall contain the lengths of the four possible ATs. The lengths are necessary for the initialization of the Type 19 hardware. Always all four lengths have to be specified. Not configured ATs shall be marked with length = 0 and the master shall not transmit these ATs. Each slave shall be informed by the master during CP2 of the lengths of all configured ATs. It shall become active in the master and slave during CP3. The length includes all data between the end of AT header to the beginning of the FCS. The number of list elements of this parameter is fixed to four.

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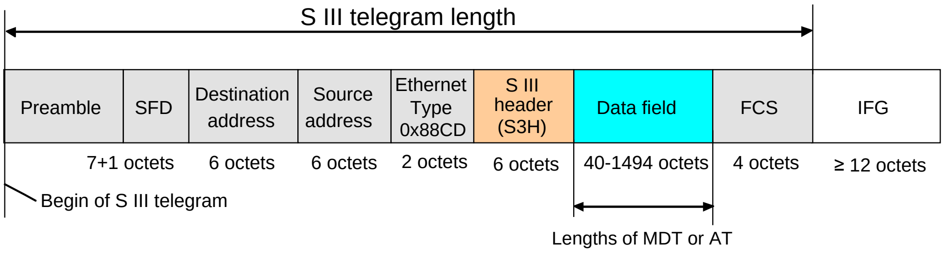

Figure A.7 – Definition of AT length

Figure A.8 shows the structure of this IDN, as an example.

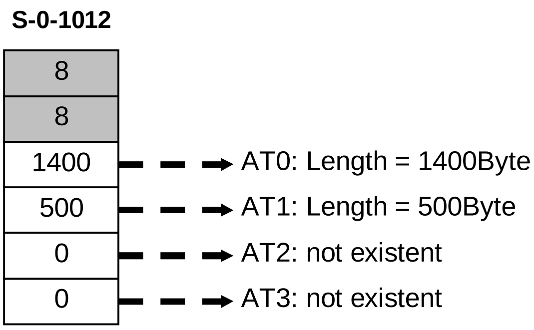

Figure A.8 – Lengths of ATs (example)

A.3.83 IDN S-0-1013 SVC offset in MDT

A.3.83.1 Attributes

Table A.101 shows the possible attributes for this IDN.

Table A.101 – Attributes of IDN S-0-1013

Attribute	Value
Name	SVC offset in MDT
Version	—
Length	2
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.83.2 Description

The SVC offset in the MDT defines the position of the service channel for the slave. This offset shall start after the Type 19 header within the related MDT. Every slave shall be informed by the master during CP2 of the offset of the service channel in the MDT. This

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parameter shall become active during CP3 in the master and slave. The SVC offset shall be an even number.

Table A.102 shows the structure of this IDN.

Table A.102 – SVC Offset in MDT

Bit number	Bit value	Description
15-14	—	(reserved)
	0	No others values allowed
13-12	—	MDT number
	00	MDT0
	01	MDT1
	10	MDT2
	11	(reserved)
11-0	—	MDT SVC-Offset (in octets)
	0...1484	MDT SVC-Offset (shall be an even number)

A.3.84 IDN S-0-1014 SVC offset in AT

A.3.84.1 Attributes

Table A.103 shows the possible attributes for this IDN.

Table A.103 – Attributes of IDN S-0-1014

Attribute	Value
Name	SVC offset in AT
Version	—
Length	2
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.84.2 Description

The SVC offset in AT defines the position of a service channel for the slave. The offset shall start after the Type 19 header within the related AT. Every slave shall be informed by the master during CP2 of the offset of the service channel in the AT. This parameter shall become active during CP3 in the master and slave. The SVC offset shall be an even number.

Table A.104 shows the structure of this IDN.

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Table A.104 – SVC Offset in AT

Bit number	Bit value	Description
15-14	—	reserved
	0	No others values allowed
13-12	—	AT-number
	00	AT0
	01	AT1
	10	AT2
	11	AT3
11-0	—	AT SVC-Offset (in octets)
	0…1484	AT SVC-Offset (shall be an even number)

A.3.85 IDN S-0-1015 Ring delay

A.3.85.1 Attributes

Table A.105 shows the possible attributes for this IDN.

Table A.105 – Attributes of IDN S-0-1015

Attribute	Value
Name	Ring delay
Version	—
Length	4
Display Format	Unsigned decimal
Min. input value	—
Max. input value	1048,575
Positions after decimal point	3
Write protection	Never
Conversion factor	1
Scaling/resolution	0,001 μs
Unit	μs

A.3.85.2 Description

The master determines the entire ring delay and assigns it to the slaves. The slaves need the ring delay to eliminate the duration of the communication and to determine their synchronization reference time (TSref).

The Master calculates the ring delay for a given line or ring topology using the following formula:

S-0-1015 Ring delay = tRing + IFG jitter + extra delay

After each power turn on, this parameter contains different values. Therefore this IDN shall not be in the S-0-0327.x.0 (IDN list of checksum parameter).

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A.3.86 IDN S-0-1016 Slave delay (P/S)

A.3.86.1 Attributes

Table A.106 shows the possible attributes for this IDN.

Table A.106 – Attributes of IDN S-0-1016

Attribute	Value
Name	Slave delay (P/S)
Version	—
Length	4, variable
Display Format	Unsigned decimal
Min. input value	0
Max. input value	—
Positions after decimal point	3
Write protection	Always
Conversion factor	1
Scaling/resolution	0,001 µs
Unit	µs

A.3.86.2 Description

After the master has assigned S-0-1015 Ring delay to the slave, it determines SYNCCNT-P and SYNCCNT-S, when S-0-1024 SYNC delay measuring procedure command is executed.

In the ring topology both list elements shall be filled with the measured values.

In the line topology:

- the greater measured value is written in the corresponding list element,
- the lower measured value is discarded and the unused list element is set to zero.

List elements:

- List element 0 is SYNCCNT-P
- List element 1 is SYNCCNT-S

A.3.87 IDN S-0-1017 UC channel transmission time

A.3.87.1 Attributes

Table A.107 shows the possible attributes for this IDN.

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Table A.107 – Attributes of IDN S-0-1017

Attribute	Value
Name	UC channel transmission time
Version	—
Length	4, variable
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	3
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	0,001 μs
Unit	μs

A.3.87.2 Description

The NRT transmission time includes two list elements (t6 & t7).

- First list element t6 (beginning of the UC channel)
  - T6 defines the time for the slave to switch the topology from RT channel to UC channel.
  - If UC channel is not required, the master shall set t6 to 0.
  - If UC channel is required master shall set t6 as specified in clause medium access.
- Second list element t7 (end of UC channel)
  - T7 defines the time for the slave to switch the topology from UC channel to RT channel.
  - If UC channel is not required, the time t7 is don't care.
  - If UC channel is required master shall set t7 as specified in clause medium access.

If the length of the UC channel is less than 125μs, S-0-1027.0.1 Requested MTU shall be adjusted accordingly.

The limits of t6 & t7 are described in 7.1.2.

A.3.88 IDN S-0-1019 MAC address

A.3.88.1 Attributes

Table A.108 shows the possible attributes for this IDN.

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Table A.108 – Attributes of IDN S-0-1019

Attribute	Value
Name	MAC address
Version	—
Length	1, variable
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.88.2 Description

The slave inserts his MAC address in this parameter.

Figure A.9 shows the structure of this IDN.

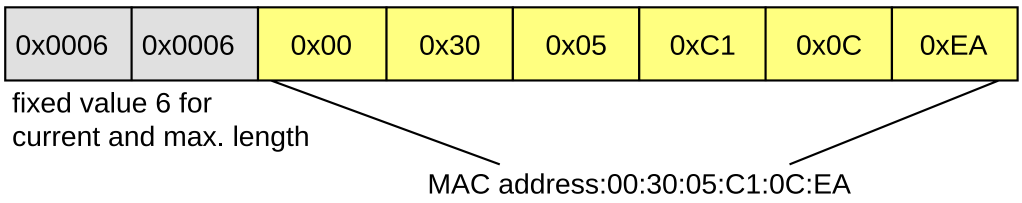

Figure A.9 – Structure of MAC address

A.3.89 IDN S-0-1020.0.1 Current IP address

A.3.89.1 Attributes

Table A.109 shows the possible attributes for this IDN.

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Table A.109 – Attributes of IDN S-0-1020.0.1

Attribute	Value
Name	Current IP address
Version	—
Length	1, variable
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.89.2 Description

This IDN contains the current IP address of the slave's Type 19 communication interface. The master may change the IP address by writing the IDN S-0-1020 (IP address) and executing the procedure command IDN S-0-1048 (Activate network settings).

Figure A.10 shows the structure of this IDN.

A.3.90 IDN S-0-1020 IP address

A.3.90.1 Attributes

Table A.110 shows the possible attributes for this IDN.

Table A.110 – Attributes of IDN S-0-1020

Attribute	Value
Name	IP address
Version	—
Length	1, variable
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Never
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.90.2 Description

For SCP_NRT: This IDN contains the IP address of the slave's Type 19 communication interface. The master may change the IP address by writing this IDN.

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For SCP_NRTPC: This IDN contains the requested IP address of the slave's Type 19 communication interface. The master may change the IP address by writing this IDN and executing the procedure command S-0-1048 (Activate network settings) to activate it. The current IP address is displayed in S-0-1020.0.1 (Current IP address).

Figure A.10 shows the structure of this IDN.

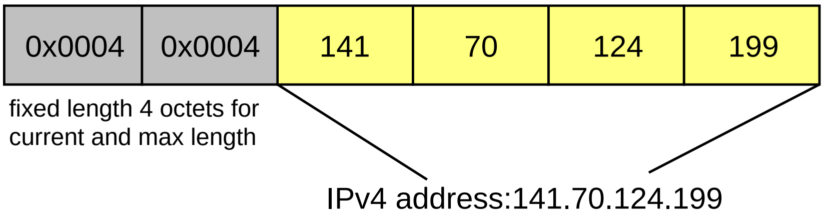

Figure A.10 – Structure of IP address

A.3.91 IDN S-0-1021.0.1 Current subnet mask

A.3.91.1 Attributes

Table A.111 shows the possible attributes for this IDN.

Table A.111 – Attributes of IDN S-0-1021.0.1

Attribute	Value
Name	Current subnet mask
Version	—
Length	1, variable
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.91.2 Description

This IDN contains the currently activated subnet mask of the slave's Type 19 communication interface. The master may change the subnet mask by writing the S-0-1021.0.0 and executing the procedure command S-0-1048 according to subclause A.3.113.

Table A.112 shows the structure of this IDN.

A.3.92 IDN S-0-1021 Subnet mask

A.3.92.1 Attributes

Table A.112 shows the possible attributes for this IDN.

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Table A.112 – Attributes of IDN S-0-1021

Attribute	Value
Name	Subnet mask
Version	—
Length	1, variable
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.92.2 Description

For SCP_NRT: This IDN contains the subnet mask of the slave's Type 19 communication interface. The master may change the subnet mask by writing this IDN.

For SCP_NRTPC: This IDN contains the subnet mask of the slave's Type 19 communication interface. The master may change the subnetmask by writing this IDN and executing the procedure command S-0-1048 (Activate network) settings to activate it. The current subnet mask is displayed in S-0-1020.0.1 (Current IP address).

Figure A.11 shows the structure of this IDN.

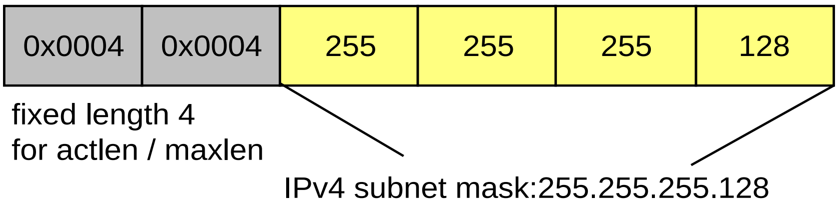

Figure A.11 – Structure of subnet mask

A.3.93 IDN S-0-1022.0.1 Current gateway address

A.3.93.1 Attributes

Table A.113 shows the possible attributes for this IDN.

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Table A.113 – Attributes of IDN S-0-1022.0.1

Attribute	Value
Name	Gateway address
Version	—
Length	1, variable
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.93.2 Description

This IDN contains the currently active gateway address of the slave's Type 19 communication interface. The master may change the gateway address by writing the S-0-1022.0.0 and executing the procedure command S-0-1048.

Figure A.12 shows the structure of this IDN.

A.3.94 IDN S-0-1022 Gateway address

A.3.94.1 Attributes

Table A.114 shows the possible attributes for this IDN.

Table A.114 – Attributes of IDN S-0-1022

Attribute	Value
Name	Gateway address
Version	—
Length	1, variable
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.94.2 Description

For SCP_NRT: This IDN contains the gateway address of the slave's Type 19 communication interface. The master may change the gateway address by writing this IDN.

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For SCP_NRTPC: This IDN contains the requested gateway address of the slave's Type 19 communication interface. The master may change the gateway address by writing this IDN and executing the procedure command S-0-1048 (Activate network settings) to activate it. The current gateway address is displayed in S-0-1020.0.1 (Current IP address).

Figure A.12 shows the structure of this IDN.

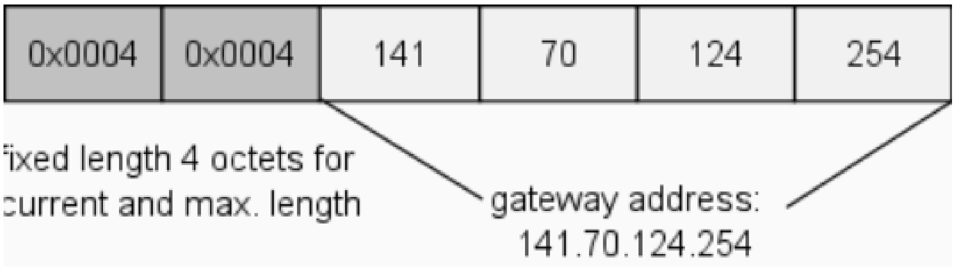

Figure A.12 – Structure of gateway address

A.3.95 IDN S-0-1023 SYNC jitter

A.3.95.1 Attributes

Table A.115 shows the possible attributes for this IDN.

Table A.115 – Attributes of IDN S-0-1023

Attribute	Value
Name	SYNC jitter
Version	—
Length	4
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	3
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	0,001 µs
Unit	µs

A.3.95.2 Description

The master shall calculate the maximum synchronization jitter. The jitter is used in the slave to determine the width of the MST window. The MST window is 2x synchronization jitter. The master shall transmit the parameter IDN S-0-1023 to all slaves supporting SCP_Sync.

The master shall calculate the maximum synchronization jitter as follows:

The maximum jitter of the transmitted MSTs (MST jitter) is dependent of the master hardware. The MST jitter is known by the master.

The maximum jitter of the Inter frame gap (IFG jitter) is dependent of the number of participants in the topology. Therefore the following formula shall be used:

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Formula of IFG jitter calculation:

$$\text{IFG jitter} \geq \frac{27 * (S-0-1037)_{MAX} * \sqrt{2 * N}}{8000} [\mu s]$$

NOTE N is the number of participants in the topology.

The SYNC jitter shall include the MST jitter and the IFG jitter and shall be greater than or equal to the deviation of the accuracy of the crystal oscillator related to the S-0-1002 Communication Cycle time (tScyc).

Example:

- S-0-1002 = 10 ms;
- accuracy = 100 μHz/Hz;
- --> deviation = 1 μs;
- the Sync Jitter shall be greater than or equal to the deviation of 1μs.

Formula of SYNC jitter calculation:

$$\text{SYNC jitter} = \frac{\text{MST jitter} + \text{IFG jitter}}{2} \geq \frac{S-0-1002}{10000\,[100\text{ppm}]} [\mu s]$$

MST jitter of ±40 ns shall be used with 80 ns in the calculation of SYNC jitter.

A.3.96 IDN S-0-1024 SYNC delay measuring procedure command

A.3.96.1 Attributes

Table A.116 shows the possible attributes for this IDN.

Table A.116 – Attributes of IDN S-0-1024

Attribute	Value
Name	SYNC delay measuring procedure command
Version	—
Length	2
Display Format	Binary
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.96.2 Description

After activation of this procedure command the slave shall determine SYNCCNT-P and SYNCCNT-S (S-0-1016 Slave delay (P&S)) depending on S-0-1015 Ring delay.

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a) In CP2 the positive acknowledgment is generated if the slave was able to determine valid SYNCCNT-P and SYNCCNT-S. In this case the slave synchronizes in CP3 or CP4 automatically.

b) In CP3 or CP4 the positive acknowledgment is generated if the slave was able to determine valid SYNCCNT-P and SYNCCNT-S and the slave has synchronized again.

The slave will generate a negative acknowledgment and set the following diagnostics:

a) S-0-1015 Ring delay is invalid (for example value = 0) --> S-0-0390 Diagnostic number is set to diagnostic code 0xC30C5301.

b) SYNCCNT-P or SYNCCNT-S is 0, or the measuring of SYNCCNT-P or SYNCCNT-S was interrupted or disturbed --> S-0-0390 Diagnostic number is set to diagnostic code 0xC30C5302.

The master shall activate this procedure command

- and wait until it is finished in CP2 before activation of S-0-0127 CP3 transition check,
- in CP3 and CP4 after the ring recovery

in every slave which has to be synchronized.

A.3.97 IDN S-0-1026 Version of communication hardware

A.3.97.1 Attributes

Table A.117 shows the possible attributes for this IDN.

Table A.117 – Attributes of IDN S-0-1026

Attribute	Value
Name	Version of communication hardware
Version	—
Length	1, variable
Display Format	Text
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.97.2 Description

This parameter includes the Type 19 communication hardware identification, for example hardware version and revision.

Example for FPGA: SERCON100M V02.01

A.3.98 IDN S-0-1027.0.1 Requested MTU

A.3.98.1 Attributes

Table A.118 shows the possible attributes for this IDN.

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Table A.118 – Attributes of IDN S-0-1027.0.1

Attribute	Value
Name	Requested MTU
Version	—
Length	2
Display Format	Unsigned decimal
Min. input value	46
Max. input value	1500
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.98.2 Description

The requested MTU defines the maximum number of octets, that may be sent within the UC channel by higher layers. This IDN only defines the target value for the MTU and is used to calculate the S-0-1027.0.2 Effective MTU. The effective value may be different from the target value, if the target value exceeds the limits of the current communication phase.

- In case of SCP_NRT the effective MTU has to be set at the Type 19 interface immediately and updated when this IDN is written or a phase change has occurred.
- In case of SCP_NRTPC the effective MTU has to be recalculated and set to the Type 19 interface by executing procedure command S-0-1048 (Activate network settings) or a phase change has occurred.

E.g. if this IDN is set to 80, the effective MTU during NRT, CP0, CP1, CP2 and HP0 will be 576 (see Table A.119).

NOTE This parameter may be used to calculate the last transmission time of the UC channel.

If Type 19 V1.1.1 devices as well as Type 19 devices of newer versions are present in the same ring, this parameter shall be set to the value 1500 on every Type 19 device newer than Type 19 V1.1.1 by the master.

Calculation of the effective MTU:

tNRT = (t7 – t6) > 6,72 μs

$$\mathrm{MTU}(\mathrm{tNRT}) = \min\left\{1500; \frac{\mathrm{tNRT}}{\mathrm{s}} * 12.498.750 - 38\right\}$$

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Table A.119 – Upper and lower Limit of MTU

Communication phase (CP)	Upper limit (CP)	Lower limit (CP)
NRT	1500	**576**
CP0	1500	**576**
CP1	1500	**576**
CP2	1500	**576**
CP3	MTU(tNRT)	46
CP4	MTU(tNRT)	46
HP0	1500	**576**
HP1	MTU(tNRT)	46
HP2	MTU(tNRT)	46

$MTU_{interim}$ = min {upperlimit(cp); $MTU_{requested}$}

$MTU_{effective}$ = max {lowerlimit(cp); $MTU_{interim}$}

Default value for this IDN shall be 1500.

A.3.99 IDN S-0-1027.0.2 Effective MTU

A.3.99.1 Attributes

Table A.120 shows the possible attributes for this IDN.

Table A.120 – Attributes of IDN S-0-1027.0.2

Attribute	Value
Name	Effective MTU
Version	—
Length	2
Display Format	Unsigned decimal
Min. input value	46
Max. input value	1500
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.99.2 Description

This IDN is the current MTU. The current MTU is calculated using IDN S-0-1017 and IDN S-0-1027.0.1. For further information see IDN S-0-1027.0.1.

A.3.100 IDN S-0-1028 Error counter MST-P/S

A.3.100.1 Attributes

Table A.121 shows the possible attributes for this IDN.

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Table A.121 – Attributes of IDN S-0-1028

Attribute	Value
Name	Error counter MST-P/S
Version	—
Length	2
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.100.2 Description

The MST error counter is incremented by one if a valid MST is neither received on port 1 nor on port 2 inside the specified MST window, see S-0-1023 SYNC jitter in communication phases 3 and 4.

The MST error counter shall stop counting as soon as it reaches 65 535. It means that if the counter has a value of 65 535, there may have been more than 65 535 invalid MST's (for example noisy transmission over a long period of time).

This counter shall be reset by the slave, if the master switches from CP2 to CP3.

A.3.101 IDN S-0-1031 Test pin assignment Port 1 & Port 2

A.3.101.1 Attributes

Table A.122 shows the possible attributes for this IDN.

Table A.122 – Attributes of IDN S-0-1031

Attribute	Value
Name	Test pin assignment Port 1 & Port 2
Version	—
Length	2
Display Format	Binary
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

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A.3.101.2 Description

This parameter is used to assign communication related hardware signals to the test pins TS1 and TS2 (see Table A.123). The assigned signal is mapped to the test pins TS1 or TS2.

Table A.123 – Structure of test pin assignment Port 1 & Port 2

Bit No.	Value	Description
15-12		**(reserved)**
11-8		The selected signal is mapped to the test pin TS2 (selectable signals are shown in the following table).
7-4		(reserved)
3-0		The selected signal is mapped to the test pin TS1 (selectable signals are shown in the following table).

Table A.124 – Selectable output signals

Value	Signal slave	Description
0000	Port 1 MST	**MST pulse from the Rx MAC of port 1 (40 ns duration)**
0001	Port 2 MST	MST pulse from the Rx MAC of port 2 (40 ns duration)
0010	TMST	TMST signal after MST generator (TSref)
0011	CON_CLK	CON Clock from the TCNT timer
0100	DIV_CLK	DIV Clock from the DIV Clock unit (only if present)
0101	TCNT Reload	Overflow of the TCNT timer
0110	Port 1 TCNT Reload	Overflow of the Port 1 timer
0111	Port 2 TCNT Reload	Overflow of the Port 2 timer
1000	Port 1 IP Open	Port 1 IP window
1001	Port 1 IP Open Write	Port 1 IP transmit window
1010	Port 2 IP Open	Port 2 IP window
1011	Port 2 IP Open Write	Port 2 IP transmit window
1100	Port 1 MST Window Open	Port 1 MST window
1101	Port 2 MST Window Open	Port 2 MST window
1110	Port 1 Rx Frame	Reception of a frame on port 1
1111	Port 2 Rx Frame	Reception of a frame on port 2

A.3.102 IDN S-0-1034 PHY error counter Port 1 & Port 2

A.3.102.1 Attributes

Table A.125 shows the possible attributes for this IDN.

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Table A.125 – Attributes of IDN S-0-1035

Attribute	Value
Name	PHY error counter Port 1 & Port 2
Version	—
Length	4
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Never
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.102.2 Description

These error counters monitor the Ethernet PHYs for error pulses.

The low word represents the error counter of port 1, the high word represents the error counter of port 2.

Due to the only supported 25MHz (100Mbit) of a Type 19 network, the value of these counters represent the amount of 40ns clock periods with "False Carrier" or "Data reception with errors" indication by the PHY over the MII interface.

This IDN is writable, so a human machine interface may reset these error counters. The maximum value for each counter is 0xFFFF. The error counters are not buffered and shall be set to 0 on power-on.

Table A.126 was extracted from the IEEE802.3 and ISO/IEC 8802-3 to show the coding of the PHY errors.

Table A.126 – Coding of PHY errors

RX_DV	RX_ER	RXD<3:0>	Indication
1	1	0000 through 1111	Data reception with errors
0	1	1110	False Carrier indication
0	1	0000	Normal inter-frame
0	1	0001 through 1101	(reserved)
0	1	1111	(reserved)

A.3.103 IDN S-0-1035 Error counter Port 1 & Port 2

A.3.103.1 Attributes

Table A.127 shows the possible attributes for this IDN.

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Table A.127 – Attributes of IDN S-0-1035

Attribute	Value
Name	Error counter Port 1 & Port 2
Version	—
Length	4
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Never
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.103.2 Description

These error counters monitor MAC telegrams, these are Type 19 telegrams as well as Ethernet telegrams.

The low word represents the error counter of port 1, the high word represents the error counter of port 2.

The counter shall start in CP0 and will be incremented maximal one time per communication cycle, if an invalid MAC telegram is detected. The error counters are writable, so a human machine interface may reset these error counters. The maximum value for each counter is 0xFFFF. The error counters are not buffered and shall be set to 0 on power-on.

Invalid telegram: The contents of invalid MAC telegrams shall not be passed to sublayers. The occurrence of invalid MAC telegrams may be communicated to network management. Invalid MAC telegrams may be ignored or discarded.

An invalid telegram shall be defined as one that meets at least one of the following conditions:

- Alignment error: It is not an integral number of octets in length.
- FCS error: The bits of the incoming telegram (exclusive of the FCS field itself) do not generate a FCS value identical to the one received.
- CRC error: The bits of the incoming telegram (exclusive of the CRC field itself of Type 19 header) do not generate a CRC value identical to the one received.
- Type 19 telegram length error: The telegram was not received with the expected length.

The MAC telegrams are checked in different ways. This is specified as shown in Table A.128:

Table A.128 – Checking of MAC telegrams

MAC telegrams	FCS	CRC	Alignment	Length
Ethernet telegrams	Yes	No	Yes	No
Type 19 telegrams	Yes	Yes	Yes	Yes

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A.3.104 IDN S-0-1036 Inter Frame Gap

A.3.104.1 Attributes

Table A.129 shows the possible attributes for this IDN.

Table A.129 – Attributes of IDN S-0-1036

Attribute	Value
Name	Inter Frame Gap
Version	—
Length	2
Display Format	Unsigned decimal
Min. input value	12
Max. input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	Octets

A.3.104.2 Description

A brief recovery time between frames allows devices to prepare for reception of the next frame. Ethernet specifies the minimum inter frame gap with 96 bits (12 octets), which is a time of 960 ns using a transmission rate of 100 Mbit/s.

The inter frame gap is dependent on S-0-1037 Slave Jitter and the number of participants (N) in the topology. The slave jitter is defined in the parameter S-0-1037 Slave Jitter and shall be read by the master of each slave. If this parameter is not supported by the slave, the master shall use a default value of 80ns. Only the greatest value of all S-0-1037 shall be used for the IFG calculation.

The formula of IFG shall be used by the master to calculate the inter frame gap for the given application.

Formula of IFG calculation:

$$S-0-1036 \geq \frac{27 * S-0-1037_{MAX} * \sqrt{2 * N}}{8000} * \frac{1\,\text{octet}}{0{,}08\,\mu s} + 12\,\text{octets}$$

The master shall transmit this inter frame gap behind every transmitted Type 19 telegram.

If the master doesn't transfer this parameter during CP2 in this case the slave shall use the default value of 37 octets.

The slave shall use this inter frame gap for its Type 19 telegram timing calculation.

The formula of tIFG and IFG jitter shall be calculate the inter frame gap as time for the given application.

Formula of tIFG calculation:

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$$tIFG \geq \frac{27 * S-0-1037_{MAX} * \sqrt{2 * N}}{8000} + 0{,}96\,\mu s$$

Formula of IFG jitter calculation:

$$IFG\ jitter \geq tIFG - 0{,}96\,\mu s$$

A.3.105 IDN S-0-1037 Slave jitter

A.3.105.1 Attributes

Table A.130 shows the possible attributes for this IDN.

Table A.130 – Attributes of IDN S-0-1037

Attribute	Value
Name	Slave Jitter
Version	—
Length	2
Display Format	Unsigned decimal
Min. input value	—
Max. input value	160
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	Octets

A.3.105.2 Description

The interface produces a telegram jitter which dependents on the hardware implementation. The slave shall show its jitter in this parameter. The master shall use this parameter to determine the inter frame gap for the transmission. The value of this parameter has to be specified by the manufacturer.

A jitter of ± 40 ns shall be shown with 80 ns in this parameter.

A.3.106 IDN S-0-1039.0.1 Current active hostname

A.3.106.1 Attributes

Table A.131 shows the possible attributes for this IDN.

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Table A.131 – Attributes of IDN S-0-1039.0.1

Attribute	Value
Name	Current active hostname
Version	—
Length	1, variable
Display Format	Text
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.106.2 Description

This parameter displays the current active network hostname of this device. The master may change the hostname by writing the S-0-1039.0.0 and executing the procedure command S-0-1048 to activate it. The device shall use this parameter in a DHCP request for identifying the node functionality in order to assign the IP address.

This parameter shall reserve at minimum a text of 16 octets.

A.3.107 IDN S-0-1039 Hostname

A.3.107.1 Attributes

Table A.132 shows the possible attributes for this IDN.

Table A.132 – Attributes of IDN S-0-1039

Attribute	Value
Name	Hostname
Version	—
Length	1, variable
Display Format	Text
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Never
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.107.2 Description

This parameter shows a network hostname of this device. The device shall use this parameter in a DHCP request for identifying the node functionality in order to assign the IP address. The contents of S-0-1039 (Hostname) shall be remanent. This parameter shall reserve at minimum a text of 16 octets.

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A.3.108 IDN S-0-1040 Sub-device address

A.3.108.1 Attributes

Table A.133 shows the possible attributes for this IDN.

Table A.133 – Attributes of IDN S-0-1040

Attribute	Value
Name	Sub-device address
Version	—
Length	2
Display Format	Unsigned decimal
Min. input value	0
Max. input value	511
Positions after decimal point	0
Write protection	Manufacturer-specific
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.108.2 Description

This parameter shall contain the sub-device address of a slave.

The address can either be set via the service channel or by means of an address switch (for example dip-switch).

Setting the sub-device address via the SVC

- The device shall apply the sub-device address immediately after the SVC write access
- The contents of S-0-1040 shall be stored remanently

Setting the sub-device address via an address switch

- The device shall always apply the sub-device address, which is shown on the address switch.

These values shall be displayed immediately.

If a device supports both ways of address configuration, it shall have the following behavior:

- If the address switch indicates an address, which is not 0
  – The device applies the address, which is shown on the address switch
  – S-0-1040 is write protected
- If the address switch indicates the address 0
  – The sub-device address can only be configured via the SVC
  – S-0-1040 is not write protected

Min/max values are mandatory and shall be adopted by the manufacturer.

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A.3.109 IDN S-0-1041 AT Command value valid time (t9)

A.3.109.1 Attributes

Table A.134 shows the possible attributes for this IDN.

Table A.134 – Attributes of IDN S-0-1041

Attribute	Value
Name	AT Command value valid time (t9)
Version	—
Length	4
Display Format	Unsigned decimal
Min. input value	0
Max. input value	tScyc
Positions after decimal point	3
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	0,001 µs
Unit	µs

A.3.109.2 Description

After the AT Command value valid time (t9) the slave can access the new command values from the AT. Thus the master can preset the same AT Command value valid time (t9) for all coordinated applications.

A.3.110 IDN S-0-1044 Device Control (C-DEV)

A.3.110.1 Attributes

Table A.135 shows the possible attributes for this IDN.

Table A.135 – Attributes of IDN S-0-1044

Attribute	Value
Name	Device Control
Version	—
Length	2
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

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A.3.110.2 Description

The device control contains the control information (for example, topology control) which are set by the master and evaluated by the slave (Table A.136). The device control is not part of a connection.

Table A.136 – Device control field (C-DEV)

Bit number	Bit value	Description
15	—	Identification
	0	No Identification request
	1	Identification request (slave shows the condition of this bit at the Type 19 LED or at the display). This function is used for the remote address allocation or for configuration errors between master and slave.
14	—	Topology HS (Initial value is 0 in every CP)
	toggle	The master toggles every time it requires a topology change.
13-12	—	Topology control (Master selects the new topology)
	00	Fast-Forward on both ports
	01	Loopback with Forward of P-Telegrams
	10	Loopback with Forward of S-Telegrams
	11	(reserved: slave shall ignore this bit combination)
11	—	Control physical topology (If the slave detects a toggle, then it shall drop the source address table. The control physical topology is used in the UC channel only)
	0	physical ring is broken
	1	physical ring is closed
10-9	—	(reserved)
8	—	Master valid (indicates if the master is processing data. In CP1 the slave detects the support of this function if this bit is set to 1 by the master)
	0	Master is not valid (The contents of device control C-DEV are invalid. Producer ready of all producer connections shall be set to 0)
	1	Master is valid (The contents of device control C-DEV are valid)
7-0	—	(reserved)

A.3.111 IDN S-0-1045 Device Status

A.3.111.1 Attributes

Table A.137 shows the possible attributes for this IDN.

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Table A.137 – Attributes of IDN S-0-1045

Attribute	Value
Name	Device Status
Version	—
Length	2
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.111.2 Description

The device status (Table A.138) contains the status information (for example, topology status) which are set by the slave and evaluated by the master. The device status is not part of a connection.

The fastest reaction time to any event affecting device status except bits 11-10 (Status of inactive port) shall be within the slowest producer cycle time but at most 200 ms.

Table A.138 – Device status field

Bit number	Bit value	Description
15	—	Communication warning interface
	0	No warning
	1	Communication warning occurred (for example number of permitted MST losses has exceeded the half value of S-0-1003
14	—	Topology HS
	toggle	Initial value is 0 in every CP. Slave toggles, if the request of the master has been recognized, that means, the topology status may be updated after the toggle.
13-10	—	Topology status / Port status
	00-00	Fast-Forward on both ports (Diagnostic not available)
	01-00	Loopback with Forward of P-Telegrams (no link on inactive port --> no device connected)
	01-01	Loopback with Forward of P-Telegrams (LINK on inactive port --> device connected)
	01-10	Loopback with Forward of P-Telegrams (P LINK: P telegrams on inactive port --> Type 19 device connected)
	01-11	Loopback with Forward of P-Telegrams (S LINK: S telegrams on inactive port --> Type 19 device connected)
	10-00	Loopback with Forward of S-Telegrams (no link on inactive port --> no device connected)
	10-01	Loopback with Forward of S-Telegrams (LINK on inactive port --> device connected)
	10-10	Loopback with Forward of S-Telegrams

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Bit number	Bit value	Description
		(P-LINK: P telegrams on inactive port --> Type 19 device connected)
	10-11	Loopback with Forward of S-Telegrams (S-LINK: S telegrams on inactive port --> Type 19 device connected)
	11-xx	store & forward or cut-through
	00-xx	Additional bit combinations:
	00-01	fast-forward on both ports (Diagnostic supported)
	00-10	fast-forward on both ports (P telegrams are missing)
	00-11	fast-forward on both ports (S telegrams are missing)
9	—	Error connection
	0	Error-free connection
	1	Error in the connection occurred (consumer recognized an error in a connection)
8	—	Slave valid (indicates if a slave is processing data)
	0	Slave not valid (Set to 0 when entering CP0. Modified during CPS. The contents of device status S-DEV are invalid. Producer ready of all producer connections shall be set to 0)
	1	Slave valid (CP > CP0. Modified during CPS the contents of device status (S-DEV) are valid)
7	—	Error (C1D), inclusive sub-device and resource errors
	0	No error
	1	Error (detailed information is shown in S-0-0390)
6	—	Warning (C2D), inclusive sub-device and resource warnings
	0	No Warning
	1	Warning (detailed information is shown in S-0-0390)
5	—	Procedure command change bit
	0	No change in procedure command acknowledgement
	1	Changing procedure command acknowledgment (procedure command is positive or negative acknowledged)
4	—	Sub-device level
	0	Operating level (OL) is active
	1	Parametrization level (PL) is active
3	—	(reserved)
2	—	(reserved)
1-0	—	(reserved)

A.3.112 IDN S-0-1047 Maximum Consumer Activation Time (t11)

A.3.112.1 Attributes

Table A.139 shows the possible attributes for this IDN.

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Table A.139 – Attributes of IDN S-0-1047

Attribute	Value
Name	Maximum Consumer Activation Time (t11)
Version	—
Length	4
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	3
Write protection	always
Conversion factor	1
Scaling/resolution	0,001 µs
Unit	—

A.3.112.2 Description

The t11 specifies the slave-specific maximum time duration that it needs between collecting consumer data from the MDTs and ATs and activating it (for example command values) in the slave.

If S-0-1060 Connection capabilities are available, t11 covers the maximum value of S-0-1060.x.07 Maximum processing time for all consumer instances of S-0-1060.

A.3.113 IDN S-0-1048 Activate network settings

A.3.113.1 Attributes

Table A.140 shows the possible attributes for this IDN.

Table A.140 – Attributes of IDN S-0-1048

Attribute	Value
Name	Activate network settings
Version	—
Length	2
Display Format	Binary
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.113.2 Description

This procedure command is used to activate requested IP-settings of the following IDN:

- S-0-1020.0.0 IP address
- S-0-1021.0.0 Subnet Mask
- S-0-1022.0.0 Gateway address

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- S-0-1027.0.1

Active settings can be displayed within the following IDN:

- S-0-1020.0.1(optional)
- S-0-1021.0.1(optional)
- S-0-1022.0.1(optional)
- S-0-1027.0.2.

A.3.114 IDN S-0-1046 List of device addresses in device

A.3.114.1 Attributes

Table A.141 shows the possible attributes for this IDN.

Table A.141 – Attributes of IDN S-0-1046

Attribute	Value
Name	List of device addresses in device
Version	—
Length	2, variable
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.114.2 Description

The multi-slave device stores the sub-device addresses of its slaves that participate in the communication (see Figure A.13). If only one slave exists in the device, this IDN may be absent.

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0x0008	Current length = 8 octets
0x0008	Max. length = 8 octets
Sub-device address	List element 0 = slave index 0
Sub-device address	List element 1 = slave index 1
Sub-device address	List element 2 = slave index 2
Sub-device address	List element 3 = slave index 3

Figure A.13 – Structure of List of Sub-device addresses

A.3.115 IDN S-0-1050.x.1 Connection setup

A.3.115.1 Attributes

Table A.142 shows the possible attributes for this IDN.

Table A.142 – Attributes of IDN S-0-1050.x.1

Attribute	Value
Name	Connection setup
Version	—
Length	2
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.115.2 Description

This parameter configures connections (Table A.143).

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Table A.143 – Connection setup

Bit number	Value	Description
15	—	Usage of connection (see note)
	0	Not used (slave shall not use this connection)
	1	Used (slave shall use this connection)
14	—	function within connection (see note)
	0	Consumer
	1	Producer
13-12	—	Source of connection configuration (see note)
	00	Master (configured by master)
	01	(reserved)
	10	External (not configured by master)
	11	(reserved)
11-6	—	(reserved)
5-4	—	type of configuration (see note)
	00	variable configuration of IDNs with S-0-1050.x.06
	01	configuration with connection length, see S-0-1050.x.05. S-0-1050.x.06 will not be considered in case of FSP I/O: The connection assignment is defined as follows: (C-CON - IO Control - S-0-1500.x.05) (C-CON - IO Status - S-0-1500.x.09) in case of FSP Drive: The connection assignment is defined as follows: (C-CON - Drive Control - S-0-1050.x.06) (C-CON - Drive Status - S-0-1050.x.06)
	10	standard telegram (see S-0-0015 of FSP Drive)
	11	reserved
3	—	mechanism of producing (for producers only, for consumers don't care)
	0	producer cycle synchronous
	1	asynchronous
2	—	reserved
1-0	—	mechanism of monitoring (for consumers only, for producers don't care)
	00	producer cycle synchronous operation (time defined by S-0-1050.x.10)
	01	asynchronous operation with watchdog (timeout for watchdog defined by product of S-0-1050.x.10 and S-0-1050.x.11)
	10	asynchronous operation without watchdog
	11	reserved

NOTE This bit is write protected if slave supports only SCP_FixCFG and additionally SCP-classes which contains S-0-1050.x.01.

A.3.116 IDN S-0-1050.x.2 Connection Number

A.3.116.1 Attributes

Table A.144 shows the possible attributes for this IDN.

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Table A.144 – Attributes of IDN S-0-1050.x.2

Attribute	Value
Name	Connection Number
Version	—
Length	2
Display Format	Unsigned decimal
Min. input value	0
Max. input value	65 535
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.116.2 Description

The connection number is used to identify a connection. The producer and all consumers of the same connection shall have the same connection number.

A.3.117 IDN S-0-1050.x.3 Telegram assignment

A.3.117.1 Attributes

Table A.145 shows the possible attributes for this IDN.

Table A.145 – Attributes of IDN S-0-1050.x.3

Attribute	Value
Name	Telegram assignment
Version	—
Length	2
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.117.2 Description

The telegram assignment contains the

- telegram type (MDT or AT), the
- telegram number and the
- telegram offset of connection control

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for this connection. The telegram type and telegram number define the Type 19 telegram of the connection. The telegram offset shall start at the end of the Type 19 header (S3H) and defines the position of the Connection control (C-CON) of this connection. The master determines the telegram assignment for each connection and shall transmit it to the related slaves in CP2 (Table A.146). The telegram assignment shall be an even number.

Table A.146 – Structure of telegram assignment

Bit number	Value	Description
15-14	—	reserved
13-12	—	Telegram number
	00	MDT0 or AT0
	01	MDT1 or AT1
	10	MDT2 or AT2
	11	MDT3 or AT3
11	—	Telegram type
	0	AT
	1	MDT
10-0	—	Telegram offset of connection control (in octets)
	0 … 1492	Telegram offset in MDT or AT (shall be an even number)

A.3.118 IDN S-0-1050.x.4 Max. Length of Connection

A.3.118.1 Attributes

Table A.147 shows the possible attributes for this IDN.

Table A.147 – Attributes of IDN S-0-1050.x.4

Attribute	Value
Name	Max. Length of Connection
Version	—
Length	2
Display Format	Unsigned decimal
Min. input value	2
Max. input value	product specific or S-0-1060.x.04
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.118.2 Description

This parameter defines the maximum length of this connection. The 2 octets for the connection control (C-CON) are part of this length. If the slave shows a length of n octets this length contains 2 octets C-CON and n-2 octets data (see Figure A.14).

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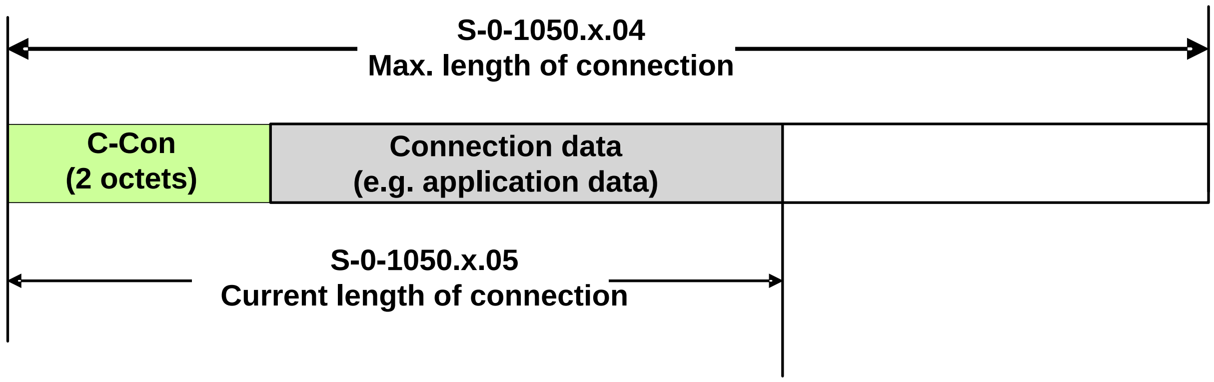

Figure A.14 – Definition of connection length

A.3.119 IDN S-0-1050.x.5 Current length of connection

A.3.119.1 Attributes

Table A.148 shows the possible attributes for this IDN.

Table A.148 – Attributes of IDN S-0-1050.x.5

Attribute	Value
Name	Current length of connection
Version	—
Length	2
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.119.2 Description

This parameter defines the current length of this connection and shall be an even number of octets. The 2 octets for the connection control (C-CON) are part of this length. If the slave shows a length of n octets this length contains 2 octets C-CON and n-2 octets data (see Figure A.14). This parameter shall be updated by the slave if configuration parameters are changed.

A.3.120 IDN S-0-1050.x.6 Configuration List

A.3.120.1 Attributes

Table A.149 shows the possible attributes for this IDN.

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Table A.149 – Attributes of IDN S-0-1050.x.6

Attribute	Value
Name	Configuration List
Version	—
Length	4, variable
Display Format	IDN
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.120.2 Description

If the connection data is configured with IDNs (type of connection, bit 5-4 = 00, in S-0-1050.x.01) this parameter contains the list of IDNs within this connection. The sequence of the IDNs in this parameter and the sequence of the corresponding operation data in the connection is identical.

A.3.121 IDN S-0-1050.x.7 Assigned connection capability

A.3.121.1 Attributes

Table A.150 shows the possible attributes for this IDN.

Table A.150 – Attributes of IDN S-0-1050.x.7

Attribute	Value
Name	Assigned connection capability
Version	—
Length	2
Display Format	Unsigned decimal
Min. input value	0
Max. input value	255 and 0xFFFF
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.121.2 Description

This parameter shows the configured connection capability of this connection. Therefore the parameter contains the structure instance of the desired connection capability (S-0-1060). If this parameter is read only the slave has a fixed connection structure.

The default value shall 0xFFFF (connection capabilities S-0-1060) is not used.

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A.3.122 IDN S-0-1050.x.8 Connection Control

A.3.122.1 Attributes

Table A.151 shows the possible attributes for this IDN.

Table A.151 – Attributes of IDN S-0-1050.x.8

Attribute	Value
Name	Connection Control
Version	—
Length	2
Display Format	Binary
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.122.2 Description

This parameter contains the image of the control word C-CON of this connection (see Table 44).

A.3.123 IDN S-0-1050.x.10 Producer cycle time

A.3.123.1 Attributes

Table A.152 shows the possible attributes for this IDN.

Table A.152 – Attributes of IDN S-0-1050.x.10

Attribute	Value
Name	Producer cycle time
Version	—
Length	4
Display Format	Unsigned decimal
Min. input value	31 250 (31,250 µs)
Max. input value	product specific
Positions after decimal point	3
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	0,001 µs
Unit	µs

A.3.123.2 Description

The Producer cycle time should be an integer multiple of the communication cycle time:

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$$tPcyc = tScyc \cdot n \quad \forall n \in N$$

Minimum and maximum input values are mandatory.

A.3.124 IDN S-0-1050.x.11 Allowed Data Losses

A.3.124.1 Attributes

Table A.153 shows the possible attributes for this IDN.

Table A.153 – Attributes of IDN S-0-1050.x.11

Attribute	Value
Name	Allowed Data Losses
Version	—
Length	2
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.124.2 Description

This parameter indicates the maximum amount of consecutive losses of producer data, before a connection is broken. If this connection is broken the consumer shall not process data anymore and sets the connection error in the device status. The default value = 1.

A.3.125 IDN S-0-1050.x.12 Error Counter Data Losses

A.3.125.1 Attributes

Table A.154 shows the possible attributes for this IDN.

Table A.154 – Attributes of IDN S-0-1050.x.12

Attribute	Value
Name	Error Counter Data Losses
Version	—
Length	2
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

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A.3.125.2 Description

This parameter counts the amount of lost producer data. Therefore, the consumer compares the C.CON.counter with its expectations. In case of an erroneous difference this error counter is incremented by 1. This counter shall be reset with the positive edge of the Producer ready in the Connection control or additionally if the master switches from CP2 to CP3. This counter does not have any overrun and ends with 65 535.

A.3.126 IDN S-0-1050.x.20 IDN Allocation of real-time bit

A.3.126.1 Attributes

Table A.155 shows the possible attributes for this IDN.

Table A.155 – Attributes of IDN S-0-1050.x.20

Attribute	Value
Name	IDN Allocation of real-time bit
Version	—
Length	4, variable
Display Format	IDN
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.126.2 Description

In order to assign signals to the real-time bits (see S-0-0398 IDN list of configurable real-time bits as producer and S-0-0399 IDN list of configurable real-time bits as consumer), the IDN of the signal is written to this parameter. After the allocation of the IDN and the bit number (see S-0-1050.x.21 Bit allocation of real-time bit), the assigned signal is copied in the corresponding real-time bit. This parameter contains maximum 2 list elements.

Real-time bit 1 and 2 are present in the S-0-1050.x.08 Connection Control (C-CON).

- List element 0 corresponds to real-time bit 1: IDN of assigned signal
- List element 1 corresponds to real-time bit 2: IDN of assigned signal

see also S-0-1050.x.21 Bit allocation of real-time bit.

A.3.127 IDN S-0-1050.x.21 IDN Allocation of real-time bit

A.3.127.1 Attributes

Table A.156 shows the possible attributes for this IDN.

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Table A.156 – Attributes of IDN S-0-1050.x.21

Attribute	Value
Name	Bit allocation of real-time bit
Version	—
Length	2, variable
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.127.2 Description

This parameter contains the bit number of the operation data assigned in the S-0-1050.x.20. The signal assigned by an IDN (S-0-1050.x.20) and a bit number (S-0-1050.x.21) is copied into the corresponding real-time bit. This list contains a maximum of 2 entries.

- List element 0 corresponds to real-time bit 1
- List element 1 corresponds to real-time bit 2

A.3.128 IDN S-0-1051 Image of connection setups

A.3.128.1 Attributes

Table A.157 shows the possible attributes for this IDN.

Table A.157 – Attributes of IDN S-0-1051

Attribute	Value
Name	Image of connection setups
Version	—
Length	2, variable
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.128.2 Description

This IDN shows the actual state of all the connections of the slave, corresponding to S-0-1050.x.1.

The quantity of list elements shows the maximum number of connections of this slave.

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A.3.129 IDN S-0-1060.x.1 Default configuration

A.3.129.1 Attributes

Table A.158 shows the possible attributes for this IDN.

Table A.158 – Attributes of IDN S-0-1060.x.01

Attribute	Value
Name	Default configuration
Version	—
Length	2
Display Format	Binary
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.129.2 Description

The structure of this parameter is identical with S-0-1050.x.01 and contains the default settings of the connection capabilities (for example consumer or producer).

A.3.130 IDN S-0-1060.x.2 Configuration mask

A.3.130.1 Attributes

Table A.159 shows the possible attributes for this IDN.

Table A.159 – Attributes of IDN S-0-1060.x.02

Attribute	Value
Name	Configuration mask
Version	—
Length	2
Display Format	Binary
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.130.2 Description

The structure of this parameter is identical with S-0-1050.x.01. The changeable configuration bits are set to 1. The not changeable configuration bits are set to 0.

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A.3.131 IDN S-0-1060.x.3 Maximum quantity of this connection capability

A.3.131.1 Attributes

Table A.160 shows the possible attributes for this IDN.

Table A.160 – Attributes of IDN S-0-1060.x.03

Attribute	Value
Name	Maximum quantity of this connection capability
Version	—
Length	2
Display Format	Unsigned decimal
Min. input value	1
Max. input value	255
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.131.2 Description

This parameter limits the number of connections (S-0-1050.x.07) within this connection capability.

A.3.132 IDN S-0-1060.x.4 Max. connection length of connection capability

A.3.132.1 Attributes

Table A.161 shows the possible attributes for this IDN.

Table A.161 – Attributes of IDN S-0-1060.x.04

Attribute	Value
Name	Max. connection length of connection capability
Version	—
Length	2
Display Format	Unsigned decimal
Min. input value	2
Max. input value	Product specific
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

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A.3.132.2 Description

This parameter defines the maximum connection length of this connection capability. The 2 octets of the connection control (C-CON) are part of this length. If the slave shows a length of n octets this length contains 2 octets C-CON and n-2 octets data.

A.3.133 IDN S-0-1060.x.6 Configurable IDNs of connection capability

A.3.133.1 Attributes

Table A.162 shows the possible attributes for this IDN.

Table A.162 – Attributes of IDN S-0-1060.x.06

Attribute	Value
Name	Configurable IDNs of connection capability
Version	—
Length	4, variable (list sorted by IDN)
Display Format	IDN
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.133.2 Description

This parameter contains the configurable IDNs of the connection capability which can be configured in the configuration list of the connection (S-0-1050.x.06).

A.3.134 IDN S-0-1060.x.7 Maximum processing time

A.3.134.1 Attributes

Table A.163 shows the possible attributes for this IDN.

Table A.163 – Attributes of IDN S-0-1060.x.07

Attribute	Value
Name	Maximum processing time
Version	—
Length	4
Display Format	Decimal
Min. input value	—
Max. input value	—
Positions after decimal point	3
Write protection	Always
Conversion factor	1
Scaling/resolution	0,001 µs
Unit	—

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A.3.134.2 Description

With this time the sub-device defines how long the data processing of the connection data takes as producer or consumer (see Figure A.15).

- producer: the generation of the producer data needs the maximum processing time (tmp-P) after the synchronization time of the producer cycle (T4pc).
- consumer: the processing of the consumer data needs the maximum processing time (tmp-C) after the end of the corresponding telegram (MDT or AT).

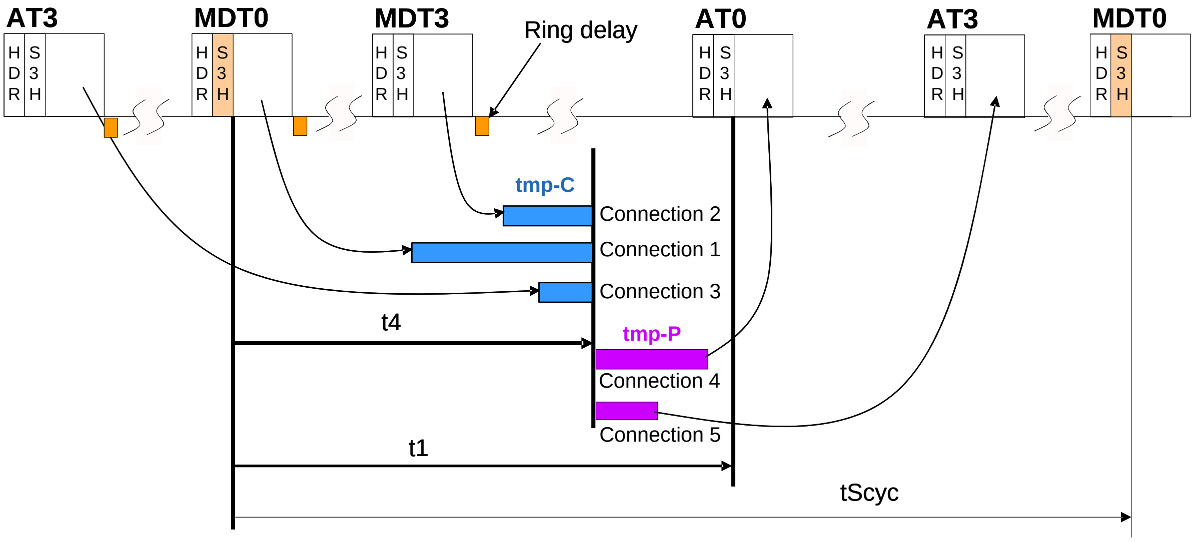

Figure A.15 – Synchronization with ring

A.3.135 IDN S-0-1060.x.10 Minimum producer cycle time

A.3.135.1 Attributes

Table A.164 shows the possible attributes for this IDN.

Table A.164 – Attributes of IDN S-0-1060.x.10

Attribute	Value
Name	Minimum producer cycle time
Version	—
Length	4
Display Format	Unsigned decimal
Min. input value	31 250 (31,250 µs)
Max. input value	—
Positions after decimal point	3
Write protection	Always
Conversion factor	1
Scaling/resolution	0,001 µs
Unit	—

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A.3.135.2 Description

This parameter contains the minimal producer cycle time which is supported for this connection capability.

A.3.136 IDN S-0-1061 Maximum TSref-Counter

A.3.136.1 Attributes

Table A.165 shows the possible attributes for this IDN.

Table A.165 – Attributes of IDN S-0-1061

Attribute	Value
Name	Maximum TSref-Counter
Version	—
Length	2
Display Format	Decimal
Min. input value	0
Max. input value	16 383
Positions after decimal point	0
Write protection	CP3, CP4
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.136.2 Description

This parameter contains the maximum value of the TSref-counter in the extended field of MDT0. This parameter is necessary if the application runs with different producer cycle times. The master shall support the following sequence:

- determination of the least common multiple (LCM) of all producer cycle times (tPcyc) which shall be synchronized for the application,
- the result is divided by the communication cycle time (tScyc) to get a LCM number based on tScyc,
- the LCM number shall be decrement by 1 and written in this parameter.

If this parameter is 0, then each of the producer cycle times are equal to the communication cycle time (each tPcyc = tScyc).

The TSref-counter in the extended field of MDT0 is 14 bit long, therefore the maximum value of this parameter is limited to the value of 16 383 (214 - 1). This parameter is used as a modulo value for TSref-counter.

A.3.137 IDN S-0-1080.x.02 Producer RTB list container

A.3.137.1 Attributes

Table A.166 shows the possible attributes for this IDN.

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Table A.166 – Attributes of IDN S-0-1080.x.02

Attribute	Value
Name	Producer RTB list container
Version	—
Length	1, variable
Display Format	Binary
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.137.2 Description

Signals can be transmitted in real-time from the producer to the consumer by means of the Producer RTB list container. For this purpose, the Producer RTB list container needs to be integrated in one producer connection.

Bits in the Producer RTB list container are definable by means of the configuration lists of the consumer RTB list container (see S-0-1080.x.03 and S-0-1080.x.04).

A.3.138 IDN S-0-1080.x.03 IDN allocation of producer RTB list container

A.3.138.1 Attributes

Table A.167 shows the possible attributes for this IDN.

Table A.167 – Attributes of IDN S-0-1080.x.03

Attribute	Value
Name	IDN allocation of producer RTB list container
Version	—
Length	4, variable
Display Format	IDN
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.138.2 Description

Bits in the Producer RTB list container (S-0-1080.x.02) are definable by means of the configuration list of the Producer RTB list container represented in this IDN. The sequence of the IDNs in the configuration list determines the bit numbering scheme in the Producer RTB

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list container. The first IDN of the configuration list with the first bit number of S-0-1080.x.04 defines bit 0 of the Producer RTB list container.

A.3.139 IDN S-0-1080.x.04 Bit allocation of producer RTB list container

A.3.139.1 Attributes

Table A.168 shows the possible attributes for this IDN.

Table A.168 – Attributes of IDN S-0-1080.x.04

Attribute	Value
Name	Bit allocation of producer RTB list container
Version	—
Length	2, variable
Display Format	Unsigned decimal (bit number)
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.139.2 Description

In this configuration list the bit numbers of the operation data are programmed, which are contained in the Producer RTB list container (S-0-1080.x.02). The sequence of the bit numbers in the configuration list sets the numerical order in the Producer RTB list container. The first bit number of the configuration list with the first IDN of S-0-1080.x.03 defines bit 0 of the Producer RTB list container.

A.3.140 IDN S-0-1081.x.02 Consumer RTB list container

A.3.140.1 Attributes

Table A.169 shows the possible attributes for this IDN.

Table A.169 – Attributes of IDN S-0-1081.x.02

Attribute	Value
Name	Consumer RTB list container
Version	—
Length	1, variable
Display Format	Binary
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

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A.3.140.2 Description

Signals can be transmitted in real-time from the producer to the consumer by means of the consumer RTB list container. For this purpose, the consumer RTB list container needs to be integrated in one consumer connection.

Bits in the consumer RTB list container are definable by means of the configuration lists of the consumer RTB list container (see S-0-1081.x.03 and S-0-1081.x.04).

A.3.141 IDN S-0-1081.x.03 IDN allocation of consumer RTB list container

A.3.141.1 Attributes

Table A.170 shows the possible attributes for this IDN.

Table A.170 – Attributes of IDN S-0-1081.x.03

Attribute	Value
Name	IDN allocation of consumer RTB list container
Version	—
Length	4, variable
Display Format	IDN
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.141.2 Description

Bits in the consumer RTB list container (S-0-1081.x.02) are definable by means of the configuration list of the consumer RTB list container represented in this IDN. The sequence of the IDNs in the configuration list determines the bit numbering scheme in the consumer RTB list container. The first IDN of the configuration list with the first bit number of S-0-1081.x.04 defines bit 0 of the Consumer RTB list container.

A.3.142 IDN S-0-1081.x.04 Bit allocation of consumer RTB list container

A.3.142.1 Attributes

Table A.171 shows the possible attributes for this IDN.

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Table A.171 – Attributes of IDN S-0-1081.x.04

Attribute	Value
Name	Bit allocation of consumer RTB list container
Version	—
Length	2, variable
Display Format	Unsigned decimal (bit number)
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.142.2 Description

In this configuration list the bit numbers of the operation data are programmed, which are contained in the Producer RTB list container (S-0-1080.x.02). The sequence of the bit numbers in the configuration list sets the numerical order in the Producer RTB list container. The first bit number of the configuration list with the first IDN of S-0-1080.x.03 defines bit 0 of the Producer RTB list container.

A.3.143 IDN S-0-1099.0.1 Test-IDN Control for SCP Conformity Purpose

A.3.143.1 Attributes

Table A.172 shows the possible attributes for this IDN.

Table A.172 – Attributes of IDN S-0-1099.0.1

Attribute	Value
Name	Test-IDN Control for SCP Conformity Purpose
Version	—
Length	2
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Never
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.143.2 Description

This IDN controls (see Table A.173) the behavior of S-0-1099.0.2 Test-IDN Container for SCP Conformity purpose and other Type 19 functionality. It is used by the Type 19 certification to check if the slave processes the data correctly. Bits 14-8 define which test-group is activated. Test-group specific tests can be selected through bits 0-7.

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Table A.173 – Structure of Test-IDN control

Bit number	Value	Description
15	—	Control type
	0	specification specific (Test-groups and test-cases follow the specification)
	1	manufacturer specific (Test-groups and test-cases are defined by the manufacturer)
14-8	—	Test-group - Describes which test-group (Bit 7-0) is used
	0	don't care (Test-IDN is not active)
	1	Real-time data
	2	SMP
7-4	—	Test-group - Real-time data
	0	don't care (Test-IDN is not active)
	1	Increment value of S-0-1099.0.2 by 1
	2	Stop toggling Con-Counter of the connection where S-0-1099.0.2 is defined cyclically for value defined in S-0-1099.0.2 cycles
3-0	—	Test-group – SMP
	0	Don’t care (Test-IDN is not active)
	1	Receive SMP-message and send back SMP-message over configured SMP-container with Session-ID+1 and priority+1 as soon as SMP-message has been received completely.

A.3.144 IDN S-0-1099.0.2 Test-IDN Container for SCP Conformity purpose

A.3.144.1 Attributes

Table A.174 shows the possible attributes for this IDN.

Table A.174 – Attributes of IDN S-0-1099.0.2

Attribute	Value
Name	Test-IDN Container for SCP Conformity purpose
Version	—
Length	2
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Never
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.144.2 Description

This IDN is used by the Type 19 certification to check if the slave processes the data correctly. For that this parameter shall be handled like any other parameter, except this parameter can be configured in a produced and a consumed connection for one slave at the

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same time. Reading the operation data of this IDN shall return the value configured through S-0-1099.0.1 (Test-IDN Control for SCP Conformity purpose).

A.3.145 IDN S-0-1100.0.1 Diagnostic counter sent SMP fragments

A.3.145.1 Attributes

Table A.175 shows the possible attributes for this IDN.

Table A.175 – Attributes of IDN S-0-1100.0.1

Attribute	Value
Name	Diagnostic counter sent SMP fragments
Version	—
Length	4
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.145.2 Description

This parameter displays the number of SMP fragments transmitted via the SMP stack since switching to CP4. The counter is set to 0 before CP4 is activated. This counter has an auto-rollover at 2^{32}-1 to 0.

A.3.146 IDN S-0-1100.0.2 Diagnostic counter received SMP fragments

A.3.146.1 Attributes

Table A.176 shows the possible attributes for this IDN.

Table A.176 – Attributes of IDN S-0-1100.0.2

Attribute	Value
Name	Diagnostic counter received SMP fragments
Version	—
Length	4
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

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A.3.146.2 Description

This parameter displays the number of SMP fragments received by the SMP stack since switching to CP4. This counter is set to 0 before CP4 is activated. This counter has an auto-rollover at 2^{32}-1 to 0.

A.3.147 IDN S-0-1100.0.3 Diagnostic counter discarded SMP fragments

A.3.147.1 Attributes

Table A.177 shows the possible attributes for this IDN.

Table A.177 – Attributes of IDN S-0-1100.0.3

Attribute	Value
Name	Diagnostic counter discarded SMP fragments
Version	—
Length	4
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.147.2 Description

This parameter displays the number of SMP fragments received by SMP stack that were discarded because its header did not match the receiver's expectations since switching to CP4. This counter is set to 0 before CP4 is activated. This counter has an auto-rollover at 2^{32}-1 to 0.

Reasons for this include:

- invalid session ID,
- wrong sequence counter,
- incorrect sequence of the FOS/LOS bits.

A.3.148 IDN S-0-1101.x.1 SMP Container Data

A.3.148.1 Attributes

Table A.178 shows the possible attributes for this IDN.

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Table A.178 – Attributes of IDN S-0-1101.x.1

Attribute	Value
Name	SMP Container Data
Version	—
Length	2, variable
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.148.2 Description

This parameter contains the actual data transmitted via a SMP container.

A.3.149 IDN S-0-1101.x.2 List of session identifiers

A.3.149.1 Attributes

Table A.179 shows the possible attributes for this IDN.

Table A.179 – Attributes of IDN S-0-1101.x.2

Attribute	Value
Name	List of session identifiers
Version	—
Length	2, variable
Display Format	unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.149.2 Description

This parameter contains the list of all session identifiers currently set up for a SMP container. Each list entry corresponds to the list entry with the same index in S-0-1101.x.03 and defines the identifier for this session.

The lists in S-0-1101.x.02 and S-0-1101.x.03 shall have the same current length.

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A.3.150 IDN S-0-1101.x.3 List of session priorities

A.3.150.1 Attributes

Table A.180 shows the possible attributes for this IDN.

Table A.180 – Attributes of IDN S-0-1101.x.3

Attribute	Value
Name	List of session priorities
Version	—
Length	2, variable
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.150.2 Description

This parameter contains a list of priority values for the sessions in this SMP container. Each list entry corresponds to the list entry with the same index in S-0-1101.x.02 and defines the priority for this session. The highest priority is 0, the lowest priority is 3.

The lists in S-0-1101.x.02 and S-0-1101.x.03 shall have the same current length.

A.3.151 IDN S-0-1150.x.01 OVS Control (C-OVS)

A.3.151.1 Attributes

Table A.181 shows the possible attributes for this IDN.

Table A.181 – Attributes of IDN S-0-1150.x.01

Attribute	Value
Name	OVS Control (C-OVS)
Version	—
Length	2
Display Format	Binary
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Never
Conversion factor	1
Scaling/resolution	1
Unit	—

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A.3.151.2 Description

The IDN contains a bit field with which the user can trigger various actions of the oversampling domain (Table A.182). The OVS control (C-OVS) is not part of the container. It may be mapped to the connection as its own IDN.

Table A.182 – OVS Control structure

Bit number	Value	Description
15	—	Quit error
	0	no action
	1	quit OVS error
14-9	—	(reserved)
8	—	Flow control (activates OVS)
	0	Run (OVS is active)
	1	Stop (OVS is passive)
7-0	—	(reserved)

A.3.152 IDN S-0-1150.x.02 OVS Status (S-OVS)

A.3.152.1 Attributes

Table A.183 shows the possible attributes for this IDN.

Table A.183 – Attributes of IDN S-0-1150.x.02

Attribute	Value
Name	OVS Status (S-OVS)
Version	—
Length	2
Display Format	Binary
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.152.2 Description

The IDN contains a bit field with which the user is informed about various states of the oversampling domain (see Table A.184). The OVS status word (S-OVS) is not part of the container. It may be mapped to the connection as its own IDN.

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Table A.184 – OVS Status structure

Bit number	Value	Description
15	—	Error
	0	the OVS state machine indicates an error
	1	no error occurs
14-9	—	(reserved)
8	—	OVS stop (indicates state of the OVS state machine)
	0	Run (OVS is active)
	1	Stop (OVS is passive)
7-0	—	(reserved)

A.3.153 IDN S-0-1150.x.03 OVS Container

A.3.153.1 Attributes

Table A.185 shows the possible attributes for this IDN.

Table A.185 – Attributes of IDN S-0-1150.x.03

Attribute	Value
Name	OVS Container
Version	—
Length	1, variable
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Conditional
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.153.2 Description

The operation data of this IDN contains the OVS data (see Table A.186 and Figure A.16).

The size of the container depends on S-0-1150.x.10 Number of Samples and the number of IDNs, which are configured in S-0-1150.x.06 Configuration List OVS - IDNs.

The order of the signals within this container follows the order in S-0-1150.x.06 Configuration List OVS - IDNs and respectively S-0-1150.x.07 Configuration List OVS - Offset and S-0-1150.x.08 Configuration List OVS - Length.

The data of each signal is stored in a bit-packed way. The data of the following signals starts at the next byte boundary (byte aligned).

If the slave is the producer of the container data, the container is always write protected.

If the slave is the consumer of the container data, the container is writable.

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Table A.186 – Configuration example

S-0-1150.x.06 (IDN)	S-0-1150.x.07 (Offset)	S-0-1150.x.08 (Length)	Explanation
S-0-0135	0	0	16 bits, starting with bit 0 of IDN "S-0-0135" are configured.
S-0-1505.4.9	0	4	4 bits, starting with bit 0 of IDN "S-0-1505.4.9" are configured.
P-0-1213.7.5	2	3	3 bits, starting with bit 2 of IDN "P-0-1213.7.5" are configured.

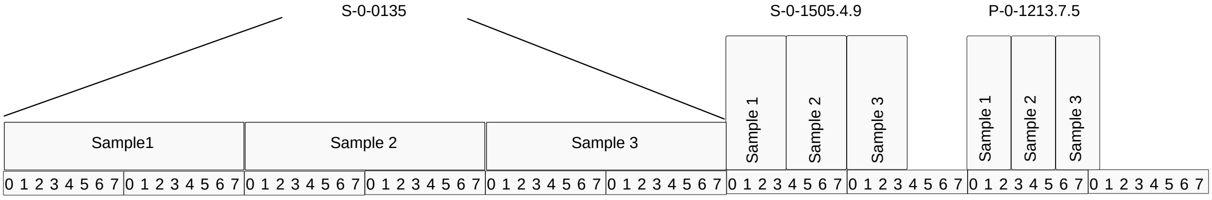

Figure A.16 – Configuration example

A.3.154 IDN S-0-1150.x.04 Sample time

A.3.154.1 Attributes

Table A.187 shows the possible attributes for this IDN.

Table A.187 – Attributes of IDN S-0-1150.x.04

Attribute	Value
Name	Sample time
Version	—
Length	4
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	OL
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.154.2 Description

This IDN contains the sample time; that is the time distance between two signals. The selection is made according to S-0-1151.x.04 Minimum sample time.

The relationship between S-0-1150.x.04 Sample time and S-0-1150.x.10 Number of Samples is the following:

- If S-0-1150.x.10 Number of Samples is written, the operation data of S-0-1150.x.04 Sample time is calculated by the slave according to: S-0-1150.x.04 Sample time = S-0-1050.x.10 Producer Cycle Time / S-0-1150.x.10 Number of Samples

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- If S-0-1150.x.04 Sample time is written, the operation data of S-0-1150.x.10 Number of Samples is calculated by the slave according to: S-0-1150.x.10 Number of Samples = S-0-1050.x.10 Producer Cycle Time / S-0-1150.x.04 Sample time. If the result is not an integer in nanoseconds it is rounded.
- If the corresponding OVS container has not been configured in a connection (for example: for OVS via SVC), no S-0-1050.x.10 is available, which can be used for the calculation of S-0-1150.x.04. In this case the configuration of the oversampling machine has to be done via S-0-1150.x.04 Sample time.

A.3.155 IDN S-0-1150.x.05 Phase shift

A.3.155.1 Attributes

Table A.188 shows the possible attributes for this IDN.

Table A.188 – Attributes of IDN S-0-1150.x.05

Attribute	Value
Name	Phase shift
Version	—
Length	4
Display Format	Signed decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	OL
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.155.2 Description

The IDN contains the value of the phase shifting for recording/output.

Only integer multiples of the minimum sample time are permitted as entry.

With this entry the recording can be shifted back and forth. The producer cycle time determines the maximum phase shifting.

A.3.156 IDN S-0-1150.x.06 Configuration List OVS - IDNs

A.3.156.1 Attributes

Table A.189 shows the possible attributes for this IDN.

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Table A.189 – Attributes of IDN S-0-1150.x.06

Attribute	Value
Name	Configuration List OVS - IDNs
Version	—
Length	4, variable
Display Format	IDN
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	OL
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.156.2 Description

The list contains entries of the type IDN.

Every entry identifies a signal that is to be sampled or output by this oversampling machine.

The user shall create the list from the data of the S-0-1151.x.06 Configurable IDNs of OVS capability list.

A.3.157 IDN S-0-1150.x.07 Configuration List OVS - Offset

A.3.157.1 Attributes

Table A.190 shows the possible attributes for this IDN.

Table A.190 – Attributes of IDN S-0-1150.x.07

Attribute	Value
Name	Configuration List OVS - Offset
Version	—
Length	2, variable
Display Format	Unsigned integer
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	OL
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.157.2 Description

This IDN contains a list of bit offsets, which can be used together with S-0-1150.x.08 Configuration List OVS - Length to address particular bit signals within the operation data of the corresponding IDN in S-0-1150.x.06 (Configuration list OVS).

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A.3.158 IDN S-0-1150.x.08 Configuration List OVS - Length

A.3.158.1 Attributes

Table A.191 shows the possible attributes for this IDN.

Table A.191 – Attributes of IDN S-0-1150.x.08

Attribute	Value
Name	Configuration List OVS - Length
Version	—
Length	2, variable
Display Format	Unsigned integer
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	OL
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.158.2 Description

This IDN contains a list of bit lengths, which can be used together with S-0-1150.x.07 Configuration List OVS - Offset to address particular bit signals within the operation data of the corresponding IDN in S-0-1150.x.06 (Configuration list OVS).

A.3.159 IDN S-0-1150.x.09 Assigned Oversampling Capability

A.3.159.1 Attributes

Table A.192 shows the possible attributes for this IDN.

Table A.192 – Attributes of IDN S-0-1150.x.09

Attribute	Value
Name	Assigned Oversampling Capability
Version	—
Length	2
Display Format	Unsigned decimal
Min. input value	0
Max. input value	255
Positions after decimal point	0
Write protection	OL
Conversion factor	1
Scaling/resolution	1
Unit	—

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A.3.159.2 Description

This parameter shows the configured OVS capability. Therefore the parameter contains the structure instance of the desired S-0-1151 OVS Capabilities.

If the slave has a static oversampling capability, this parameter shall be read only.

A.3.160 IDN S-0-1150.x.10 Number of Samples

A.3.160.1 Attributes

Table A.193 shows the possible attributes for this IDN.

Table A.193 – Attributes of IDN S-0-1150.x.10

Attribute	Value
Name	Number of Samples
Version	—
Length	2
Display Format	Unsigned decimal
Min. input value	1
Max. input value	—
Positions after decimal point	0
Write protection	OL
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.160.2 Description

This IDN contains the number of values to be sampled.

The value of the operation data has to be less or equal than S-0-1151.x.01 Maximum number of samples.

NOTE The relationship between S-0-1150.x.04 Sample time and S-0-1150.x.10 Number of Samples is described in FG Oversampling.

A.3.161 IDN S-0-1151.x.01 Maximum number of samples

A.3.161.1 Attributes

Table A.194 shows the possible attributes for this IDN.

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Table A.194 – Attributes of IDN S-0-1151.x.01

Attribute	Value
Name	Maximum number of samples
Version	—
Length	2
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.161.2 Description

The IDN contains the maximum number of sampled/output values.

The operation data of this IDN is a synonym for the available memory capacity and should be seen as a worst case value. This means, that there might be configurations of S-0-1150.x.06 Configuration List OVS - IDNs, which do not allow the maximum number of samples, as specified in this IDN.

A.3.162 IDN S-0-1151.x.02 Internal resolution

A.3.162.1 Attributes

Table A.195 shows the possible attributes for this IDN.

Table A.195 – Attributes of IDN S-0-1151.x.02

Attribute	Value
Name	Internal resolution
Version	—
Length	2
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	always
Conversion factor	1
Scaling/resolution	1
Unit	ns

A.3.162.2 Description

The IDN contains the internal resolution of signals that are to be sampled/output. This value will typically deviate from S-0-1151.x.04 Minimum sample time, because the

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acceptance/transfer, storage and management takes more time than permitted by the time basis generated in the hardware.

A.3.163 IDN S-0-1151.x.03 Maximum quantity of this oversampling capability

A.3.163.1 Attributes

Table A.196 shows the possible attributes for this IDN.

Table A.196 – Attributes of IDN S-0-1151.x.03

Attribute	Value
Name	Maximum quantity of this oversampling capability
Version	—
Length	2
Display Format	Unsigned decimal
Min. input value	1
Max. input value	255
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.163.2 Description

The IDN contains the maximum number of signals that can be sampled/output at the same time within a domain. This data item is a synonym for the available resources of the oversampling hardware. That means that several signals can be stored when the signals of the domain to be sampled/output (S-0-1151.x.06 Configurable IDNs of OVS capability) are selected well and the memory is managed efficiently.

A.3.164 IDN S-0-1151.x.04 Minimum sample time

A.3.164.1 Attributes

Table A.197 shows the possible attributes for this IDN.

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Table A.197 – Attributes of IDN S-0-1151.x.04

Attribute	Value
Name	Minimum sample time
Version	—
Length	4
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	always
Conversion factor	1
Scaling/resolution	1
Unit	ns

A.3.164.2 Description

This IDN contains the minimum sample time, which is the smallest possible time distance between two sampled/output signal values.

The actual sampled/output time is defined in S-0-1150.x.04 Sample time.

A.3.165 IDN S-0-1151.x.06 Configurable IDNs of OVS capability

A.3.165.1 Attributes

Table A.198 shows the possible attributes for this IDN.

Table A.198 – Attributes of IDN S-0-1151.x.06

Attribute	Value
Name	Configurable IDNs of OVS capability
Version	—
Length	4, variable
Display Format	IDN
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.165.2 Description

The list contains entries of the type IDN. Every entry identifies a signal that can be sampled/output with this oversampling machine.

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A.3.166 IDN S-0-1151.x.07 Configurable IDNs of OVS Capability - Offset

A.3.166.1 Attributes

Table A.199 shows the possible attributes for this IDN.

Table A.199 – Attributes of IDN S-0-1151.x.07

Attribute	Value
Name	Configurable IDNs of OVS Capability - Offset
Version	—
Length	2, variable
Display Format	Unsigned integer
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.166.2 Description

The list contains bit offsets of the corresponding IDNs listed in S-0-1151.x.06 Configurable IDNs of OVS capability. Every entry identifies a signal that can be sampled/output with this oversampling machine.

A.3.167 IDN S-0-1151.x.08 Configurable IDNs of OVS Capability - Length

A.3.167.1 Attributes

Table A.200 shows the possible attributes for this IDN.

Table A.200 – Attributes of IDN S-0-1151.x.08

Attribute	Value
Name	Configurable IDNs of OVS Capability - Length
Version	—
Length	2, variable
Display Format	Unsigned integer
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

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A.3.167.2 Description

The list contains bit lengths of the corresponding IDNs listed in S-0-1151.x.06 Configurable IDNs of OVS capability. Every entry identifies a signal that can be sampled/output with this oversampling machine.

If "0" is entered as length, the corresponding entry in S-0-1151.x.07 Configurable IDNs of OVS Capability - Offset is ignored and the entire operation data of the IDN defined in S-0-1151.x.06 is selectable for sampling/output.

A.3.168 IDN S-0-1153 Amount of OVS Domains

A.3.168.1 Attributes

Table A.201 shows the possible attributes for this IDN.

Table A.201 – Attributes of IDN S-0-1151.x.08

Attribute	Value
Name	Amount of OVS Domains
Version	—
Length	2
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

A.3.168.2 Description

This IDN contains the amount of oversampling domains provided by the slave.

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Annex B
(normative)

SCP– Classification

B.1 General concept of profiling

Type 19 offers two different views upon the grouping of IDNs. One view is the point of view of the specification, the other one is the point of view of an application.

Figure B.1 shows the technical view. Each IDN is existent in a function group. A function group is a functional grouping of IDNs. Each function group is existent in a so called profile area. This profile area may either be SCP, GDP or a FSP (for example: FSP_Drive, FSP_IO).

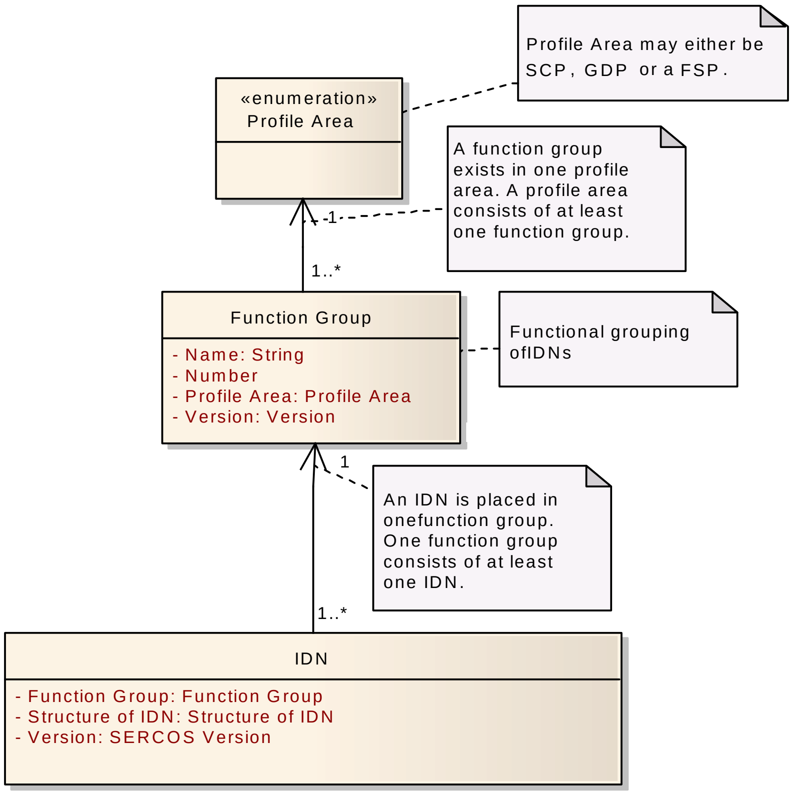

Figure B.1 – Technical Profiling in Type 19

An application expects certain functionalities in a device. So another view upon the profiling is introduced. This is called application profiling. Application profiling uses classes to group functionality described in the technical specification to groups that can be implemented in devices. This is to help device manufactures of slave devices to decide which functionality may be grouped in a reasonable way. On the other hand this view also helps master manufactures, since this classing provides an easy view upon the slave device.

For the profile areas SCP and GDP an IDN exists, which shows the classes implemented in a device:

a) SCP: IDN S-0-1000 once per slave

b) GDP: IDN S-0-1301 once per sub-device

For modular structured devices, the following IDN for the FSP profile area exists:

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a) FSP: IDN S-0-1302.x.2 one for each resource in the sub-device

B.2 Function Groups related to the SCP

B.2.1 FG SCP Identification

The function group FG SCP Classification groups all IDNs that are related to the classification of a slave on SCP level.

This function group includes the following IDNs:

- IDN S-0-1000.0.1 Active SCP Classes
- IDN S-0-1000 SCP Type & Version

B.2.2 FG Timing

The function group FG Timing groups all IDNs that are related to the timing. This function group includes the following IDNs:

- IDN S-0-1002 Communication Cycle time (tScyc)
- IDN S-0-1005 Minimum feedback processing time (t5)
- IDN S-0-1006 AT0 transmission starting time (t1)
- IDN S-0-1008 Command value valid time (t3)
- IDN S-0-1023 SYNC jitter
- IDN S-0-1036 Inter Frame Gap
- IDN S-0-1037 Slave Jitter
- IDN S-0-1041 AT Command value valid time (t9)
- IDN S-0-1047 Maximum Consumer Activation Time (t11)
- IDN D-0-1060.x.01 Default Configuration
- IDN D-0-1060.x.02 Configuration mask
- IDN D-0-1060.x.03 Maximum quantity of connection capability
- IDN D-0-1060.x.04 Maximum connection length of connection capability
- IDN D-0-1060.x.06 Configurable IDNs of connection capability
- IDN D-0-1060.x.07 Maximum processing time
- IDN D-0-1060.x.10 Minimum producer cycle time

B.2.3 FG Telegram Setup

The function group FG Telegram Setup groups all IDNs that are related to the configuration of the telegrams. This function group includes the following IDNs:

- IDN S-0-1009 Device Control (C-DEV) offset in MDT
- IDN S-0-1010 Lengths of MDTs
- IDN S-0-1011 Device Status (S-DEV) offset in AT
- IDN S-0-1012 Length of ATs
- IDN S-0-1013 SVC offset in MDT
- IDN S-0-1014 SVC offset in AT

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B.2.4 FG Control

The function group FG Control groups all IDNs that are related to the control of the communication state machine of the slave. This function group includes the following IDNs:

- IDN S-0-0021 IDN-list of invalid operation data for CP2
- IDN S-0-0022 IDN-list of invalid operation data for CP3
- IDN S-0-0127 CP3 transition check
- IDN S-0-0128 CP4 transition check

B.2.5 FG Bus-Diagnosis

The function group FG Bus-Diagnosis groups all IDNs, which are related to bus diagnosis. This function group includes the following IDNs:

- IDN S-0-0014 Interface Status
- IDN S-0-1003 Allowed MST losses in CP3/CP4
- IDN S-0-1026 Version of communication hardware
- IDN S-0-1028 Error counter MST-P/S
- IDN S-0-1031 Test pin assignment Port 1 & Port 2
- IDN S-0-1034 PHY error counter Port 1 & Port 2
- IDN S-0-1035 Error counter Port1 and Port2
- IDN S-0-1040 Sub-device address
- IDN S-0-1044 Device Control (C-DEV)
- IDN S-0-1045 Device Status (S-DEV)
- IDN S-0-1046 List of Sub-device addresses in device

B.2.6 FG Connection

The function group FG Connection groups all IDNs that are related the configuration of connections. This function group includes the following IDNs:

- IDN S-0-0187 IDN-list of configurable data as producer
- IDN S-0-0188 IDN-list of configurable data as consumer
- IDN S-0-1050.x.01 Connection setup
- IDN S-0-1050.x.02 Connection Number
- IDN S-0-1050.x.03 Telegram Assignment
- IDN S-0-1050.x.04 Max. Length Of Connection
- IDN S-0-1050.x.05 Current length of connection
- IDN S-0-1050.x.06 Configuration List
- IDN S-0-1050.x.07 Assigned connection capability
- IDN S-0-1050.x.08 Connection Control (C-CON)
- IDN S-0-1050.x.09 Connection State
- IDN S-0-1050.x.10 Producer Cycle Time
- IDN S-0-1050.x.11 Allowed Data Losses
- IDN S-0-1050.x.12 Error Counter Data Losses
- IDN S-0-1050 Connections
- IDN S-0-1051 Image of connection setups

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B.2.7 FG NRT

The function group FG Connection groups all IDNs that are related to the communication in the UC channel. This function group includes the following IDNs:

- IDN S-0-1017 NRT transmission time
- IDN S-0-1019 MAC Address
- IDN S-0-1020.0.1 Current IP address
- IDN S-0-1020 IP address
- IDN S-0-1021.0.1 Current subnet Mask
- IDN S-0-1021 Subnet Mask
- IDN S-0-1022.0.1 Current active gateway address
- IDN S-0-1022 Gateway address
- IDN S-0-1027.0.1 Requested MTU
- IDN S-0-1027.0.2 Effective MTU
- IDN S-0-1039.0.1 Current active hostname
- IDN S-0-1039 Hostname
- IDN S-0-1048 Activate network settings

and the following Control and Status Bits

- C-DEV/Control physical topology

B.2.8 FG MUX

The function group FG Mux groups all IDNs that are related the usage of the multiplex channel within a connection. This function group includes the following IDNs:

- IDN S-0-0360 MDT data container A1
- IDN S-0-0361 MDT data container B1
- IDN S-0-0362 MDT data container A list index
- IDN S-0-0363 MDT data container B list index
- IDN S-0-0364 AT data container A1
- IDN S-0-0365 AT data container B1
- IDN S-0-0366 AT data container A list index
- IDN S-0-0367 AT data container B list index
- IDN S-0-0368 Data container A pointer
- IDN S-0-0369 Data container B pointer
- IDN S-0-0370 MDT data container A/B configuration list
- IDN S-0-0371 AT data container A/B configuration list
- IDN S-0-0444 IDN-list of configurable data in the AT data container
- IDN S-0-0445 IDN-list of configurable data in the MDT data container
- IDN S-0-0450 MDT data container A2
- IDN S-0-0451 MDT data container A3
- IDN S-0-0452 MDT data container A4
- IDN S-0-0453 MDT data container A5
- IDN S-0-0454 MDT data container A6

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- IDN S-0-0455 MDT data container A7
- IDN S-0-0456 MDT data container A8
- IDN S-0-0457 MDT data container A9
- IDN S-0-0458 MDT data container A10
- IDN S-0-0459 MDT data container B2
- IDN S-0-0480 AT data container A2
- IDN S-0-0481 AT data container A3
- IDN S-0-0482 AT data container A4
- IDN S-0-0483 AT data container A5
- IDN S-0-0484 AT data container A6
- IDN S-0-0485 AT data container A7
- IDN S-0-0486 AT data container A8
- IDN S-0-0487 AT data container A9
- IDN S-0-0488 AT data container A10
- IDN S-0-0489 AT data container B2
- IDN S-0-0490 MDT data container A2 configuration list
- IDN S-0-0491 MDT data container A3 configuration list
- IDN S-0-0492 MDT data container A4 configuration list
- IDN S-0-0493 MDT data container A5 configuration list
- IDN S-0-0494 MDT data container A6 configuration list
- IDN S-0-0495 MDT data container A7 configuration list
- IDN S-0-0496 MDT data container A8 configuration list
- IDN S-0-0497 MDT data container A9 configuration list
- IDN S-0-0498 MDT data container A10 configuration list
- IDN S-0-0500 AT data container A2 configuration list
- IDN S-0-0501 AT data container A3 configuration list
- IDN S-0-0502 AT data container A4 configuration list
- IDN S-0-0503 AT data container A5 configuration list
- IDN S-0-0504 AT data container A6 configuration list
- IDN S-0-0505 AT data container A7 configuration list
- IDN S-0-0506 AT data container A8 configuration list
- IDN S-0-0507 AT data container A9 configuration list
- IDN S-0-0508 AT data container A10 configuration list

B.2.9 FG SMP

The function group FG SMP groups all IDNs that are related to the usage of the Type 19 Messaging Protocol (SMP). This function group includes the following IDNs:

- IDN S-0-1100.0.01 Diagnostic counter sent SMP fragments
- IDN S-0-1100.0.02 Diagnostic counter received SMP fragments
- IDN S-0-1100.0.03 Diagnostic counter dropped SMP fragments
- IDN S-0-1101.x.01 SMP Container Data
- IDN S-0-1101.x.02 List of session identifiers

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- IDN S-0-1101.x.03 List of session priorities

B.2.10 FG RTB

The function group FG RTB groups all IDNs that are related to the usage of the Real Time Bits. This function group includes the following IDNs:

- IDN S-0-0026 IDN allocation of producer RTB word container
- IDN S-0-0027 IDN allocation of consumer RTB word container
- IDN S-0-0144 Producer RTB word container
- IDN S-0-0145 Consumer RTB word container
- IDN S-0-0328 Bit allocation of producer RTB word container
- IDN S-0-0329 Bit allocation of consumer RTB word container
- IDN S-0-0398 IDN list of configurable real-time bits as producer
- IDN S-0-0399 IDN list of configurable real-time bits as consumer
- IDN S-0-1050.x.20 IDN Allocation of real-time bit
- IDN S-0-1050.x.21 Bit allocation of real-time bit
- IDN S-0-1080.x.02 Producer RTB list container
- IDN S-0-1080.x.03 IDN allocation of producer RTB list container
- IDN S-0-1080.x.04 Bit allocation of producer RTB list container
- IDN S-0-1081.x.02 Consumer RTB list container
- IDN S-0-1081.x.03 IDN allocation of consumer RTB list container
- IDN S-0-1081.x.04 Bit allocation of consumer RTB list container

and the following Control and Status Bits

- C-CON/Real-time bit 1
- C-CON/Real-time bit 1

B.3 Type 19 communication classes

B.3.1 General

Type 19 defines several communication classes that may be implemented by slaves. Two of these define the basic communication and are mutually exclusive:

- SCP_FixCFG
- SCP_VarCFG

The other communication classes may be implemented on top of them.

B.3.2 SCP_FixCFG

SCP_FixCfg is a basic class in the SCP. A slave, that implements SCP_FixCfg, provides the following features at the communication level:

- A full-featured service channel (SVC).
- Cyclic device control and device status words.
- Exact two connections are supported, one as consumer and one as producer:
  - The connection which is produced may be placed in any AT, and uses structure instance 0 (IDN S-0-1050.0.y). The position of this connection is not dependent on the place where device status is placed.

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  - The connection which is consumed may either be placed in any MDT or AT, and uses structure instance 1 (IDN S-0-1050.1.y). The position of this connection is not dependent on the place where device control is placed.
- The content of the connections is defined by the slave and cannot be changed by the master
- All listed IDNs and Bits are mandatory in SCP_FixCFG.

This class includes the following IDNs:

- IDN S-0-0021 IDN-list of invalid operation data for CP2
- IDN S-0-0022 IDN-list of invalid operation data for CP3
- IDN S-0-0127 CP3 transition check
- IDN S-0-0128 CP4 transition check
- IDN S-0-1000 SCP Type & Version
- IDN S-0-1002 Communication Cycle time (tScyc)
- IDN S-0-1003 Allowed MST losses in CP3/CP4
- IDN S-0-1009 Device Control (C-DEV) offset in MDT
- IDN S-0-1010 Lengths of MDTs
- IDN S-0-1011 Device Status (S-DEV) offset in AT
- IDN S-0-1012 Length of ATs
- IDN S-0-1013 SVC offset in MDT
- IDN S-0-1014 SVC offset in AT
- IDN S-0-1017 NRT transmission time
- IDN S-0-1026 Version of communication hardware
- IDN S-0-1035 Error counter Port1 and Port2
- IDN S-0-1040 Sub-device address
- IDN S-0-1046 List of Sub-device addresses in device
- IDN S-0-1050.x.3 Telegram Assignment
- IDN S-0-1050.x.5 Current length of connection

This class includes the following Control and Status Bits:

- C-CON/New data (new producer data)
- C-CON/Producer ready
- C-DEV/Identification
- C-DEV/Topology HS
- C-DEV/Topology control
- S-DEV/Communication warning interface
- S-DEV/Error connection
- S-DEV/Port status
- S-DEV/Procedure command change bit
- S-DEV/Slave valid
- S-DEV/Sub-device level
- S-DEV/Topology HS
- S-Dev/Topology status

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B.3.3 SCP_FixCFG_0x02

The class SCP_FixCFG_0x02 is version 0x02 of the class SCP_FixCFG. The support of a SCP class latest version implies automatically the support of all lower versions of this class too. This version is a backward compatible enhancement to the class SCP_FixCFG.

This class includes the following IDN:

- IDN S-0-1037 Slave Jitter

B.3.4 SCP_FixCFG_0x03

The class SCP_FixCFG_0x03 is version 0x03 of the class SCP_FixCFG. The support of a SCP class latest version implies automatically the support of all lower versions of this class too. This version is a backward compatible enhancement to the class SCP_FixCFG.

This class includes the following IDN:

- IDN S-0-1050.x.09 Connection State

This class includes the following Control and Status Bits:

- C-CON/Counter
- C-CON/Flow-control

B.3.5 SCP_VarCFG

SCP_VarCfg is a basic class in the SCP. A slave, that implements SCP_VarCfg, provides the following features on the communication level:

- A full-featured service channel.
- Cyclic device control and status words.
- A certain number of connections is supported. The slave defines this number and provides it to the master.
  - The connections which are consumed may either be placed in any MDT or AT. The position of this connection is not dependent on the place where device control is placed.
  - The connections which are produced may be placed in any AT. The position of this connection is not dependent on the place where device status is placed.
- The content of all connections have to be configured (for example by the master). The slave provides lists of IDNs that can be cyclically produced and consumed, so the master can find it out.
- All listed IDNs and Bits are mandatory in SCP_VarCFG.

This class includes the following IDNs:

- IDN S-0-0014 Interface Status
- IDN S-0-0021 IDN-list of invalid operation data for CP2
- IDN S-0-0022 IDN-list of invalid operation data for CP3
- IDN S-0-0127 CP3 transition check
- IDN S-0-0128 CP4 transition check
- IDN S-0-0187 IDN-list of configurable data as producer
- IDN S-0-0188 IDN-list of configurable data as consumer
- IDN S-0-1000 SCP Type & Version
- IDN S-0-1002 Communication Cycle time (tScyc)

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- IDN S-0-1003 Allowed MST losses in CP3/CP4
- IDN S-0-1009 Device Control (C-DEV) offset in MDT
- IDN S-0-1010 Lengths of MDTs
- IDN S-0-1011 Device Status (S-DEV) offset in AT
- IDN S-0-1012 Length of ATs
- IDN S-0-1013 SVC offset in MDT
- IDN S-0-1014 SVC offset in AT
- IDN S-0-1017 NRT transmission time
- IDN S-0-1026 Version of communication hardware
- IDN S-0-1035 Error counter Port1 and Port2
- IDN S-0-1040 Sub-device address
- IDN S-0-1046 List of Sub-device addresses in device
- IDN S-0-1050.x.01 Connection setup
- IDN S-0-1050.x.02 Connection Number
- IDN S-0-1050.x.03 Telegram Assignment
- IDN S-0-1050.x.04 Max. Length Of Connection
- IDN S-0-1050.x.05 Current length of connection
- IDN S-0-1050.x.06 Configuration List
- IDN S-0-1051 Image of connection setups

This class includes the following Control and Status Bits:

- C-CON/New data (new producer data)
- C-CON/Producer ready
- C-DEV/Identification
- C-DEV/Topology HS
- C-DEV/Topology control
- S-DEV/Communication warning interface
- S-DEV/Error connection
- S-DEV/Port status
- S-DEV/Procedure command change bit
- S-DEV/Slave valid
- S-DEV/Sub-device level
- S-DEV/Topology HS
- S-DEV/Topology status

B.3.6 SCP_VarCFG_0x02

The class SCP_VarCFG_0x02 is an add-on to the class SCP_VarCFG. It contains information for heterogeneous connections. The class SCP_VarCFG_0x02 is version 0x02 of the class SCP_VarCFG. The support of a SCP class latest version implies automatically the support of all lower versions of this class too. This version is a backward compatible enhancement to the class SCP_VarCFG.

This class includes the following IDN:

- IDN S-0-1037 Slave Jitter

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B.3.7 SCP_VarCFG_0x03

The class SCP_VarCFG_0x03 is version 0x03 of the class SCP_VarCFG. The support of a SCP class latest version implies automatically the support of all lower versions of this class too. This version is a backward compatible enhancement to the class SCP_VarCFG.

This class includes the following IDN:

- IDN S-0-1050.x.09 Connection State

This class includes the following Control and Status Bits:

- C-CON/Counter
- C-CON/Flow-control

B.3.8 SCP_Sync

SCP_Sync is a class in the SCP. A slave, that implements SCP_Sync, provides the ability to isochronously produce and consume cyclic data.

This class includes the following IDNs:

- IDN S-0-1005 Minimum feedback processing time (t5)
- IDN S-0-1006 AT0 transmission starting time (t1)
- IDN S-0-1007 Feedback acquisition capture point (t4)
- IDN S-0-1008 Command value valid time (t3)
- IDN S-0-1015 Ring delay
- IDN S-0-1016 Slave delay (P/S)
- IDN S-0-1023 SYNC jitter
- IDN S-0-1024 SYNC delay measuring procedure command
- IDN S-0-1041 AT Command value valid time (t9)
- IDN S-0-1050.x.01 Connection setup
- IDN S-0-1050.x.10 Producer Cycle Time
- IDN S-0-1050.x.11 Allowed Data Losses
- IDN S-0-1050.x.12 Error Counter Data Losses

This class includes the following Control and Status Bits:

- C-CON/Data field delay
- C-CON/Producer synchronization

B.3.9 SCP_Sync

SCP_Sync is a class in the SCP. A slave, that implements SCP_Sync, provides the ability to isochronously produce and consume cyclic data.

This class includes the following IDNs:

- S-0-1005 Minimum feedback processing time (t5)
- S-0-1006 AT0 transmission starting time (t1)
- S-0-1007 Synchronization time (Tsync)
- S-0-1008 Command value valid time (t3)
- S-0-1015 Ring delay

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- S-0-1016 Slave delay (P&S)
- S-0-1023 SYNC jitter
- S-0-1024 SYNC delay measuring procedure command
- S-0-1041 AT Command value valid time (t9)
- S-0-1050.x.01 Connection setup
- S-0-1050.x.10 Producer Cycle Time
- S-0-1050.x.11 Allowed Data Losses
- S-0-1050.x.12 Error Counter Data Losses

And the following Control or Status Bits

- C-CON/Data field delay
- C-CON/Producer synchronization

B.3.10 SCP_Sync_0x02

SCP_Sync_0x02 is a class in the Type 19 Communication profile. A slave, that implements SCP_Sync_0x02, provides the ability to isochronously produce and consume cyclic data with a producing cycle time (tPcyc) > Type 19 cycle time (tScyc). The class SCP_Sync_0x02 is version 0x02 of the class SCP_Sync. The support of a SCP class latest version implies automatically the support of all lower versions of this class too. This version is a backward compatible enhancement to the class SCP_Sync.

This class includes the following IDNs:

- IDN S-0-1028 Error counter MST-P&S
- IDN S-0-1036 Inter Frame Gap
- IDN S-0-1047 Maximum Consumer Activation Time (t11)

B.3.11 SCP_Sync_0x03

The class SCP_Sync_0x03 is version 0x03 of the class SCP_Sync. The support of a SCP class latest version implies automatically the support of all lower versions of this class too. This version is a backward compatible enhancement to the class SCP_Sync.

This class includes the following IDN:

- IDN S-0-1061 Maximum TSref-Counter

B.3.12 SCP_WD

SCP_WD is a class in the SCP. A slave, that implements SCP_WD, provides the ability to monitor connections that are consumed by the slave.

This class includes the following IDNs:

- IDN S-0-1050.x.01 Connection setup
- IDN S-0-1050.x.10 Producer Cycle Time

B.3.13 SCP_WD_0x02

SCP_WD_0x02 is a class in the Type 19 communication profile. A slave, that implements this class x02, provides the ability to supervise the communication produce with watchdog. The class SCP_WD_0x02 is version 0x02 of the class SCP_WD. The support of a SCP class latest version implies automatically the support of all lower versions of this class too. This version is a backward compatible enhancement to the class SCP_WD.

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This class includes the following IDN:

- IDN S-0-1050.x.11 Allowed Data Losses

B.3.14 SCP_Diag

SCP_Diag is a class in the SCP. A slave, that implements SCP_Diag, provides information that can help to do bus-diagnosis.

This class includes the following IDNs:

- IDN S-0-0021 IDN-list of invalid operation data for CP2
- IDN S-0-0022 IDN-list of invalid operation data for CP3
- IDN S-0-1031 Test pin assignment Port 1 & Port 2
- IDN S-0-1044 Device Control (C-DEV)
- IDN S-0-1045 Device Status (S-DEV)
- IDN S-0-1050.x.08 Connection Control (C-CON)
- IDN S-0-1050.x.12 Error Counter Data Losses

In addition the Type 19 LED is supported.

B.3.15 SCP_RTB

SCP_RTB is a class in the SCP. A slave that implements SCP_RTB provides the ability to produce and consume real-time bits. Real-time bits are signals which indicate some selected status or event which are represented in real time.

This class includes the following IDNs:

- IDN S-0-0398 IDN list of configurable real-time/status bits
- IDN S-0-0399 IDN list of configurable real-time/control bits
- IDN S-0-1050.x.20 IDN Allocation of real-time bit
- IDN S-0-1050.x.21 Bit allocation of real-time bit

This class includes the following Control or Status Bits

- C-CON/Real-time bit 1
- C-CON/Real-time bit 2

B.3.16 SCP_HP

SCP_HP is a class in the SCP. A slave that implements SCP_HP provides the ability to be hot-plugged. That means it can be integrated into a Type 19 network which is already in communication phase 4. There are no IDNs related to this ability but the slave must implement the usage of the Hotplug-fields in MDT and AT.

B.3.17 SCP_SMP

SCP_SMP is a class in the SCP. A slave, which implements SCP_SMP provides the ability to talk part in a connection that uses the Type 19 messaging protocol.

This class includes the following IDNs:

- IDN S-0-1100.0.01 Diagnostic counter sent SMP fragments
- IDN S-0-1100.0.02 Diagnostic counter received SMP fragments
- IDN S-0-1100.0.03 Diagnostic counter dropped SMP fragments

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- IDN S-0-1101.x.01 SMP Container Data
- IDN S-0-1101.x.02 List of session identifiers
- IDN S-0-1101.x.03 List of session priorities

B.3.18 SCP_Mux

SCP_MuX is a class in the SCP. A slave, that implements SCP_MuX provides the ability to produce and consume cyclic data that are multiplexed a standard data container in one connection.

This class includes the following IDNs:

- IDN S-0-0360 MDT data container A1
- IDN S-0-0361 MDT data container B1
- IDN S-0-0364 AT data container A1
- IDN S-0-0365 AT data container B1
- IDN S-0-0368 Data container A pointer
- IDN S-0-0369 Data container B pointer
- IDN S-0-0370 MDT data container A/B configuration list
- IDN S-0-0371 AT data container A/B configuration list

B.3.19 SCP_Ext_Mux

SCP_ExtMuX is a class in the SCP. A slave, that implements SCP_ExtMuX provides the ability to produce and consume cyclic data that are multiplexed an extended data container in one connection.

This class includes the following IDNs:

- IDN S-0-0360 MDT data container A1
- IDN S-0-0364 AT data container A1
- IDN S-0-0368 Data container A pointer
- IDN S-0-0370 MDT data container A/B configuration list
- IDN S-0-0371 AT data container A/B configuration list
- IDN S-0-0450 MDT data container A2
- IDN S-0-0480 AT data container A2
- IDN S-0-0490 MDT data container A2 configuration list
- IDN S-0-0500 AT data container A2 configuration list

B.3.20 SCP_NRT

SCP_NRT is a class in the SCP. A slave, that implements SCP_NRT, provides the ability to an active use the NRT-channel for transmission and reception of non-SIII-Ethernet-frames.

This class shall not be implemented in new devices. Please implement SCP_NRTPC instead.

This class includes the following IDNs:

- IDN S-0-1019 MAC Address
- IDN S-0-1020 IP address
- IDN S-0-1021 Subnet Mask

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- IDN S-0-1022 Gateway address
- IDN S-0-1027.0.1 Requested MTU
- IDN S-0-1027.0.2 Effective MTU

B.3.21 SCP_Sig

SCP_Sig is a class in the SCP. A slave, that implements SCP_Sig, provides the ability to produce a signal status word and to consume a signal control word. Signals can be transmitted in real-time of the signal control word and signal status word. For this purpose, the signal control and the signal status word have to be configured into a connection.

This class includes the following IDNs:

- IDN S-0-0026 Configuration list for signal status word
- IDN S-0-0027 Configuration list for signal control word
- IDN S-0-0144 Signal status word
- IDN S-0-0145 Signal control word
- IDN S-0-0328 Bit number allocation list for signal status word
- IDN S-0-0329 Bit number allocation list for signal control word
- IDN S-0-0398 IDN list of configurable real-time/status bits
- IDN S-0-0399 IDN list of configurable real-time/control bits

B.3.22 SCP_ListSeg

SCP_ListSeg is a sub profile of SCP it contains the segmentwise access of parameters with variable length

This class includes the following IDNs:

- IDN S-0-0394 List IDN
- IDN S-0-0395 List index
- IDN S-0-0396 Number of list elements
- IDN S-0-0397 List segment

B.3.23 SCP_IPS

SCP_IPS is a class in the SCP. A slave that implements SCP_IPS provides the ability to an active use of the NRT-channel for transmission and reception defined by Type 19 networks.

The IPS group the following two kinds of services:

- S/IP services, which are Type 19 specific services based on UDP or TCP
- Further TFTP based services

B.3.24 SCP_Cap

SCP_Cap is a class in the Type 19 CommunicationProfile. A slave, that implements SCP_Cap, provides the ability to show his communication capabilities

This class includes the following IDNs:

- IDN S-0-1050.x.07 Assigned connection capability
- IDN S-0-1060.x.01 Default configuration
- IDN S-0-1060.x.02 Configuration mask

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- IDN S-0-1060.x.03 Maximum quantity of this connection capability
- IDN S-0-1060.x.04 Max. connection length of connection capability
- IDN S-0-1060.x.06 Configurable IDNs of connection capability
- IDN S-0-1060.x.07 Maximum processing time
- IDN S-0-1060.x.10 Minimum producer cycle time
- IDN S-0-1060 Connection capabilities

B.3.25 SCP_RTBListProd

If a slave shows the class SCP_RTBListProd, then it supports the Real-time bit list container as producer.

This class includes the following IDNs:

- IDN S-0-0398 IDN list of configurable real-time bits as producer
- IDN S-0-1080.x.02 Producer RTB list container
- IDN S-0-1080.x.03 IDN allocation of producer RTB list container
- IDN S-0-1080.x.04 Bit allocation of producer RTB list container

B.3.26 SCP_RTBListCons

If a slave shows the class SCP_RTBListCons, then it supports the Real-time bit list container as consumer.

This class includes the following IDNs:

- IDN S-0-0399 IDN list of configurable real-time bits as consumer
- IDN S-0-1081.x.02 Consumer RTB list container
- IDN S-0-1081.x.03 IDN allocation of consumer RTB list container
- IDN S-0-1081.x.04 Bit allocation of consumer RTB list container

B.3.27 SCP_SysTime

If a slave shows the class SCP_SysTime, then it supports the system time transmitted by the master in the extended field of MDT0.

B.3.28 SCP_RTBWordProd

If a slave shows the class SCP_RTBWordProd, then it supports the Real-time word as producer.

This class includes the following IDNs:

- IDN S-0-0026 IDN allocation of producer RTB word container
- IDN S-0-0144 Producer RTB word container
- IDN S-0-0328 Bit allocation of producer RTB word container
- IDN S-0-0398 IDN list of configurable real-time bits as producer

B.3.29 SCP_RTBWordCons

If a slave shows the class SCP_RTBWordCons, then it supports the Real-time word as consumer.

This class includes the following IDNs:

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- IDN S-0-0027 IDN allocation of consumer RTB word container
- IDN S-0-0145 Consumer RTB word container
- IDN S-0-0329 Bit allocation of consumer RTB word container
- IDN S-0-0399 IDN list of configurable real-time bits as consumer

B.3.30 SCP_SafetyCon

SCP_SafetyCon is a class in the Type 19 Communication Profile. A slave, that implements SCP_SafetyCon, provides the CSoS functionality.

This class includes the following IDNs:

- IDN S-0-1810.x.01 SV Max data age
- IDN S-0-1810.x.02 Safety Validator state
- IDN S-0-1810.x.03 SV Error code
- IDN S-0-1810.x.04 Safety Validator type
- IDN S-0-1810.x.05 SV Time coord msg min multiplier
- IDN S-0-1810.x.06 SV Max consumer number
- IDN S-0-1810.x.07 SV Timeout multiplier
- IDN S-0-1810.x.08 SV Ping interval EPI multiplier
- IDN S-0-1810.x.09 SV Network time expectation multiplier
- IDN S-0-1830.x.01 Cyclic SMP container (out)
- IDN S-0-1830.x.02 Cyclic SMP Session ID (out)
- IDN S-0-1830.x.03 List of cyclic SMP containers (in)
- IDN S-0-1830.x.04 List of cyclic SMP Session IDs (in)
- IDN S-0-1830.x.05 List of UCM SMP containers (in)
- IDN S-0-1830.x.07 List of UCM SMP containers (out)
- IDN S-0-1830.x.08 List of UCM SMP Session IDs (out)
- IDN S-0-1830.x.09 List of consumer numbers

B.3.31 SCP_OvS_Basic

SCP_OvSBasic is a class in the Type 19 Communication Profile. A slave, that implements SCP_OvSBasic, provides the basic mechanism of the oversampling functionality.

This class includes the following IDNs:

- IDN S-0-1150.x.01 OVS Control (C-OVS)
- IDN S-0-1150.x.02 OVS Status (S-OVS)
- IDN S-0-1150.x.03 OVS Container
- IDN S-0-1150.x.06 Configuration List OVS - IDNs
- IDN S-0-1150.x.10 Number of Samples

And the following Control or Status Bits

- C-OVS Flow control
- C-OVS Quit error
- S-OVS error
- S-OVS stop

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B.3.32 SCP_NRTPC

SCP_NRTPC is a class in the SCP. A slave, that implements SCP_NRTPC, provides the ability to an active use the NRT-channel for transmission and reception of “non Type 19” Ethernet-frames.

This class includes the following IDNs:

- IDN S-0-1019 MAC Address
- IDN S-0-1020 IP address
- IDN S-0-1021 Subnet Mask
- IDN S-0-1022 Gateway address
- IDN S-0-1027.0.1 Requested MTU
- IDN S-0-1027.0.2 Effective MTU
- IDN S-0-1048 Activate network settings

B.3.33 SCP_Cyc

SCP_Cyc is a class in the Type 19 Communication Profile. A slave, that implements SCP_Cyc, provides the ability to produce and consume cyclic data.

This class includes the following IDNs:

- IDN S-0-1005 Minimum feedback processing time (t5)
- IDN S-0-1006 AT0 transmission starting time (t1)
- IDN S-0-1047 Maximum Consumer Activation Time (t11)

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Annex C
(normative)

GDP (Generic Device Profile)

C.1 General

The objective of the Generic Device Profile (GDP) is to provide for a sight to the sub-device that is not dependent of the function specific profile (FSP) that is implemented by the sub-device. The following parts are independent of the FSP:

- Identification
- Administration
- Archiving
- GDP state machines allow a decoupling of communication and applications state machine

C.2 Function Groups

C.2.1 Function Group Diagnosis

The grouping of IDNs in the function group diagnosis has the aim to provide a defined interface for diagnosis tasks to the master. This includes the tasks of accessing diagnostic numbers and messages and the corresponding timestamps as well as the resetting of those.

This function group includes the following IDNs:

- S-0-0095 Diagnostic message
- S-0-0099 Reset class 1 diagnostic
- S-0-0390 Diagnostic number
- S-0-1303.0.01 Diagnostic trace configuration
- S-0-1303.0.02 Diagnostic trace control
- S-0-1303.0.03 Diagnostic trace state
- S-0-1303.0.10 Diagnostic trace buffer no1
- S-0-1303.0.11 Diagnostic trace buffer no2
- S-0-1303.0.12 Diagnostic trace buffer no3
- S-0-1303 Diagnostic trace

In addition to these IDNs a light emitting diode (Type 19 LED) is part of this function group. Two LEDs are defined:

- one labeled with S for the indication of the communication status
- one for each sub-device labeled with SDx for the indication of the sub-device status of sub-device x.

If the SDx LED is supported, there shall be one for each sub-device in the device labeled SD1, SD2, SD3, etc.

If the device contains only one sub-device this label shall be SD.

S LED

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It is mandatory that a Type 19 device shows the states as shown in Table C.1 via a LED which is labeled with S or via another display element.

The slave device indicates the communication state machine and three additional independent states. These are Loopback, C1D and identification. The colors and priority are shown in Table C.1. The state identification is shown with highest priority.

Table C.1 – Type 19 LED

Pattern	Color	Description	Prio.	Comment
#1	dark	NRT-Mode	0	no Type 19 communication
#2	orange	CP0	0	communication phase 0 is active
#3	orange	CP1	0	communication phase 1 is active
#4		CP2	0	communication phase 2 is active
#5		CP3	0	communication phase 3 is active
#6	green	CP4	0	communication phase 4 is active
#7		HP0	1	Device is in hot-plug phase 0
#8		HP1	1	Device is in hot-plug phase 1
#9		HP2	1	Device is in hot-plug phase 2
#10		Fast forward ⇒ Loopback	2	RT-state has changed from fast-forward to loopback
#11		application error	3	see GDP & FSP Status codes class error
#12		MST losses ≥ (S-0-1003/2)	4	as long as the communication warning (S-DEV.Bit15) in the Device Status is present, at least 2 sec.
#13	red	communication error	5	see SCP Status codes class error
#14		Identification	6	(C-DEV.Bit 15 in the Device Control) used for address allocation, configuration error or other identification purposes
#15		Watchdog error	7	

The time division for LED flashing shall be 250 ms (4 Hz).

***SDx* LED**

In addition to the Type 19 LED another optional LED is specified (see Table C.2). This additional LED shows the status of the sub-device.

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Table C.2 – SDx LED

Pattern	Color	Description	Prio.	Comment
#1	dark	sub-device not active	0	
#2	orange	parametrization level (PL)	0	sub-device is in parametrization level (PL)
#3	green	operating level (OL)	0	sub-device is in operating level (OL)
#4	red	application error (C1D)	1	see GDP & FSP Status codes class error

C.2.2 Function Group Archiving

The grouping of IDNs in the function group archiving has the aim to provide a defined interface for archiving tasks to the master. This includes the tasks of accessing lists of data that has to be stored to do a backup, the checksums related to this data, procedure commands to perform the backup as well as restore it.

This function group includes the following IDNs:

- S-0-0192 IDN-list of all backup operation data
- S-0-0262 Load defaults procedure command
- S-0-0263 Load working memory procedure command
- S-0-0264 Backup working memory procedure command
- S-0-0269 Storage mode
- S-0-0270 IDN list of selected backup operation data
- S-0-0293 Selectively backup working memory procedure command
- S-0-0326.x.0 Parameter Checksum
- S-0-0327.x.0 IDN list of checksum parameter
- S-0-0531 Checksum for backup operation data
- S-0-1310 IDN List of operation data changed from default

C.2.3 Function Group Administration

The grouping of IDNs in the function group administration has the aim to provide a defined interface for administration tasks to the master. This includes the tasks of setting the language in the sub-device as well as setting a password for changing a list of data.

This function group includes the following IDNs:

- S-0-0017 IDN-list of all operation data
- S-0-0025 IDN-list of all procedure commands
- S-0-0265 Language selection
- S-0-0266 List of available languages
- S-0-0267 Password
- S-0-0279 IDN list of password protected data

C.2.4 Function Group Identification

The grouping of IDNs in the function group identification has the aim to provide a defined interface for identification tasks to the master. This includes the tasks of accessing all electronic labels of all available components of the device. Therefore each of these components is represented by a structure instance (SI) of the electronic label parameter (S-0-

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1300). Another task covered by this GDP function group is to describe the functional view upon the sub-device. This means the description of the application layer within the sub-device (GDP + FSPs).

This function group includes the following IDNs:

- S-0-1300.x.01 Component Name
- S-0-1300.x.02 Vendor Name
- S-0-1300.x.03 Vendor Code
- S-0-1300.x.04 Device Name
- S-0-1300.x.05 Vendor Device ID
- S-0-1300.x.06 Connected to sub-device
- S-0-1300.x.07 Function Revision
- S-0-1300.x.08 Hardware Revision
- S-0-1300.x.09 Software Revision
- S-0-1300.x.10 Firmware Loader Revision
- S-0-1300.x.11 Order Number
- S-0-1300.x.12 Serial Number
- S-0-1300.x.13 Manufacturing Date
- S-0-1300.x.14 QA Date
- S-0-1300.x.20 Operational Hours
- S-0-1300.x.21 Service Date
- S-0-1300.x.22 Calibration Date
- S-0-1300.x.23 Calibration Due Date
- S-0-1300 Electronic Label
- S-0-1301 List of GDP classes & Version
- S-0-1302.x.01 FSP Type & Version
- S-0-1302.x.02 Function groups
- S-0-1302.x.03 Application Type
- S-0-1302 Resource Structures of sub-device

C.2.5 Function Group State machine

C.2.5.1 The sub-device state machine

In addition to the communication state machine each sub-device has to implement a sub-device state machine, which represents the operating state of the application (see Figure C.1).

In general the sub-device state machine has two states, the operating level and the parameterization level.

- Parameterization level (PL)
  - Within the parameterization level,
    - the sub-device deactivates the monitoring of the attached resources (for example encoder, motor, IO). The resource specific actions, which are required to change to parameterization level, are described within resource specific state machines (for example IO_state_machine or Drive state machine). With the activation of the parameterization level the corresponding monitoring bits of the resource status

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words (for example S-0-1500.x.02 IO Status Bit 15 (outputs ready-to-operate) or S-0-0135 Drive status bits 15 and 14) are set to 0.

- parameters which are write protected in parameterization level (PL) cannot be changed.
- since certain monitoring functions are switched off, assemblies of a sub-device can be exchanged.
- Bit 4 (Sub-device level) of the Device Status word is set to "1" (parameterization level (PL) is active).

- Operating level (OL)
  - Within the operating level:
    - The sub-device is ready for running the application. All monitoring systems are switched on.
    - Parameters which are write protected in operating level (OL) cannot be changed.
    - Bit 4 (Sub-device level) of the Device Status word is set to "0" (operating level (OL) is active).
    - As long as the sub-device does not support the class "GDP_StM" the sub-device state machine is coupled to the communication state machine. The following figure shows the dependency of the sub-device state machine from the communication state machine.

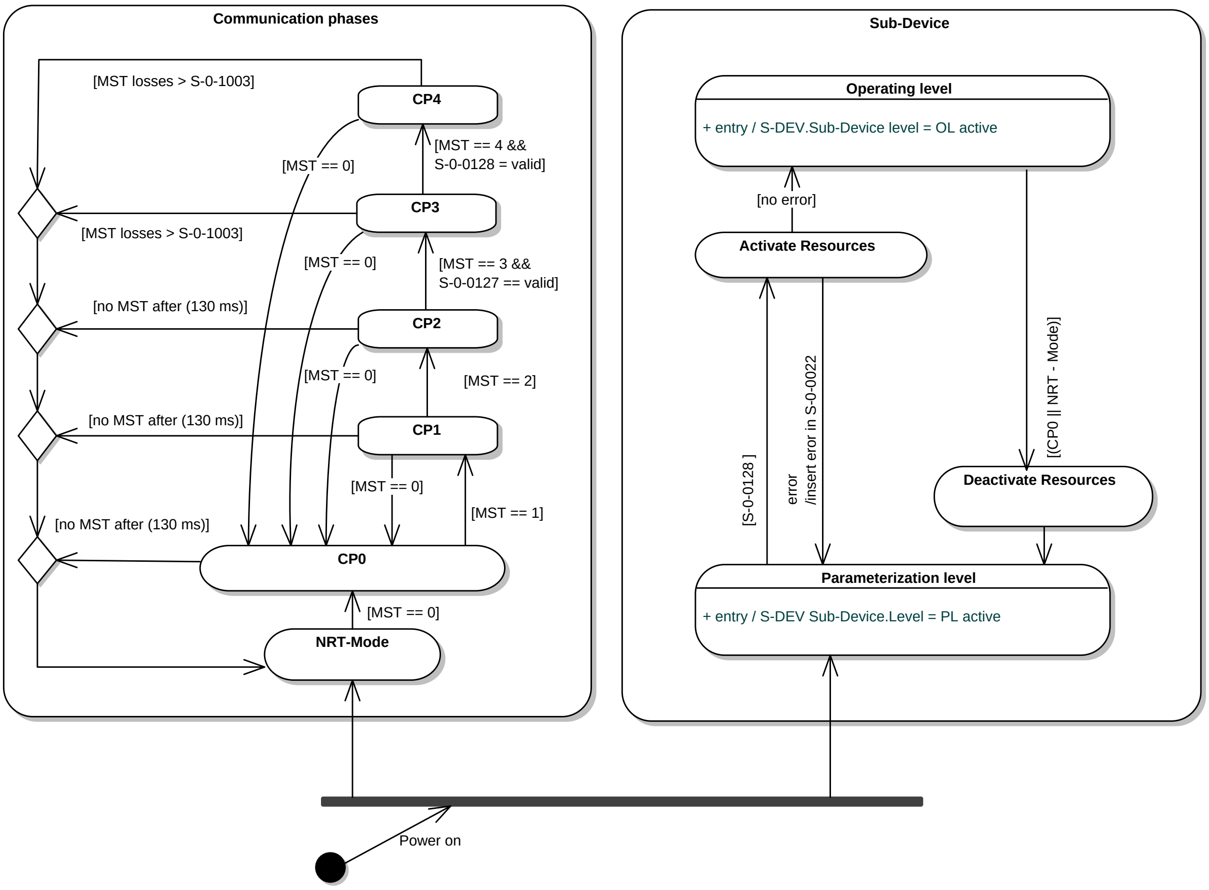

Figure C.1 – State machine without class GDP_StM

Without the support of the class "GDP_StM" the parameterization level gets active:

- After a restart of the slave.

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- With an entry to NRT Mode or CP0.

Without the support of the class "GDP_StM" the operating level gets active:

- With the successful execution of procedure command S-0-0128 CP4 transition check

C.2.5.2 Decoupled state machines

C.2.5.2.1 Overview

The parameters of the function group "State Machine" have the aim to provide an interface, which controls the sub-device state machine independently from the communication state machine (Figure C.2). The following IDNs are defined within this function group:

- An IDN for the activation of the parameterization level (S-0-0420 Activate parametrization level procedure command (PL))
- An IDN for the activation of the operating level (S-0-0422 Exit parameterization level procedure command)
- An IDN for the error handling during the activation of the operating level (S-0-0423 IDN-list of invalid data for parameterization level)
- An IDN to control the coupling and decoupling of the communication and the sub-device state machine (S-0-0425 Sub-device state machine control)

The slave can realize this interface by supporting the class "GDP_StM".

In order to control the state machine of the sub-device independent from the communication state machine, the following commandos have to be executed:

- S-0-0420 Activate parametrization level procedure command (PL)
- S-0-0422 Exit parameterization level procedure command

In order to control, whether or not a change of the communication state machine leads to a transition of the sub-device state machine, S-0-0425 Sub-device state machine control is used.

The following figure shows how the IDNs, which are defined within the function group "State Machine", control the sub-device state machine.

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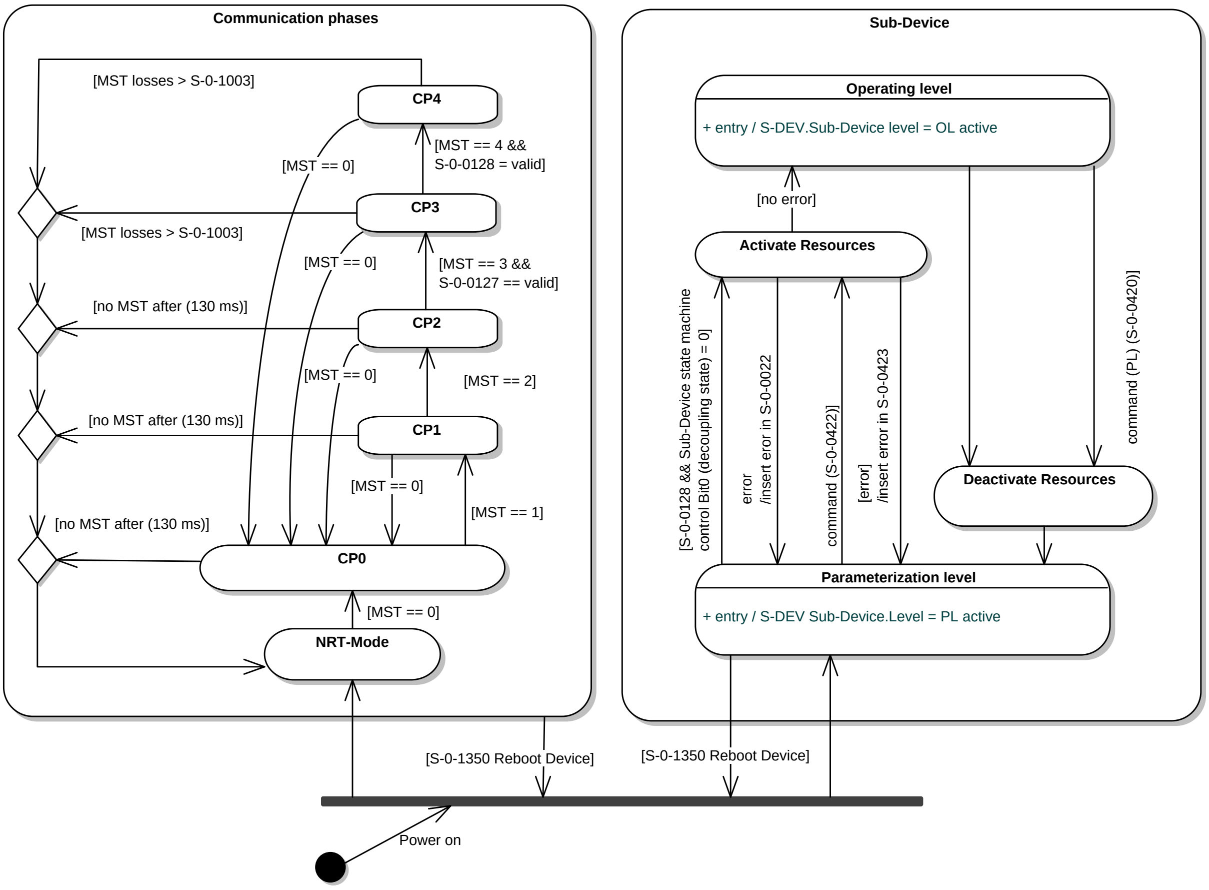

Figure C.2 – State machine without class GDP_StM

By supporting the class "GDP_StM" amongst others the following uses cases become possible.

C.2.5.2.2 Re-Parameterization during real time data transfer

The procedure command S-0-0420 Activate parametrization level procedure command (PL) makes it possible to change parameters, that are write protected in operating level and whose write protection is bound to the sub-device state machine, without leaving communication phase CP3/CP4. This can be useful if application specific parameters of a specific sub-device have to be adjusted while the applications of other connected slaves remain activated.

In order to exit the operating level the master has to activate the procedure command S-0-0420 Activate parametrization level procedure command (PL) in the sub-device. After the procedure command has been executed the sub-device shuts down its application and switches internally to the parameterization level, in which the communication of the active communication phase is maintained. While the sub-device is in parameterization level the master is able to change parameters which are writable in the current communication phase and in PL. After the parameter setup the master can re-activate the application of the sub-device by executing procedure command S-0-0422 Exit parameterization level procedure command.

C.2.5.2.3 Obviation of application activation

In some cases (for example during commissioning) it might not be possible to run the application of a specific sub-device. In this case a switch to CP4 without the support of the class "GDP_StM" is not possible, since the procedure command S-0-0128 CP4 transition check, which amongst others checks if the application is ready to run, would fail.

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By supporting the class "GDP_StM" the sub-device offers the possibility to explicitly obviate the switch to the operating level and therefore allows a communication phase switch to CP4 with a deactivated application. This behavior is achieved by setting bit 0 (decoupling state) of S-0-0425 Sub-device state machine control to 1 (decoupled) before the execution of procedure command S-0-0128 CP4 transition check.

If the procedure command S-0-0128 CP4 transition check is executed and bit 0 of S-0-0425 Sub-device state machine control is set, the execution of S-0-0128 CP4 transition check is carried out in the sub-device without checks and generates a positive acknowledge.

C.2.5.2.4 Early run of the application

In some situations (for example during commissioning) where a cyclic communication (communication phases CP3 and CP4) is not possible, it is required to access a running application within the sub-device via the SVC or S/IP in order to test sub-functions of the application. The support of the class "GDP_StM" allows the user to activate the application within the device before the activation of the application is done implicitly with procedure command S-0-0128 CP4 transition check.

The early activation of the application is done by executing the procedure command S-0-0422 Exit parameterization level procedure command in earlier communication phases (NRT Mode-CP3, typically CP2). Once the application has been activated before S-0-0128 CP4 transition check, the sub-device state machine is already activated and thus the execution of S-0-0128 CP4 transition check is carried out in the sub-device without checks. In this case the procedure command S-0-0128 CP4 transition check generates a positive acknowledge.

C.2.5.2.5 Continuation of operating level

Some applications require a continuous operational state of specific slaves, independent from the current communication phase. By supporting the class "GDP_StM" the sub-device offers the possibility to keep the application running despite communication phase changes to a lower communication phase (for example NRT Mode, CP0).

In order to keep the application running, independent of communication phase changes, S-0-0425 Sub-device state machine control.Bit0 (decoupling state) has to be set to 1 (decoupled).

This function group includes the following IDNs:

- S-0-0420 Activate parametrization level procedure command (PL)
- S-0-0422 Exit parameterization level procedure command
- S-0-0423 IDN-list of invalid data for parameterization level
- S-0-0425 Sub-device state machine control
- S-0-1350.0.1 Reboot Device Delay
- S-0-1350 Reboot Device

And the following Control and Status Bits

- S-DEV/Sub-device level

C.2.6 Function Group Time

This function group describes the transmission and activating of the Type 19 time in the slave related to the current time in the master. The master shall calculate a predicted time (forecast) to compensate the transmission delay.

The parameter S-0-1305.0.01 contains the current Type 19 time in IEC 61588 format. The sub-device may mark events with this time (for example S-0-1305.0.01 marks the diagnoses trace with time stamps).

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This function group includes the following IDNs:

- S-0-1305.0.01 Type 19 current time
- S-0-1305.0.02 Type 19 current fine time

C.2.7 Function Group Conformance Test GDP

This function group contains IDNs which are required by the conformance test.

The following IDNs shall not be listed within the operation data of S-0-0017 (IDN-list of all operation data)

- S-0-1399.0.1 Test IDN Diagnostic Event

C.3 Classification

C.3.1 General

Several GDP classes may be implemented by sub-devices.

The GDP defines one class (GDP_Basic) which provides the minimum of functionality that is needed in a sub-device on the application level. The class GDP_Basic shall be implemented by all sub-devices.

The other GDP classes may be implemented on top of them.

C.3.2 GDP_Basic

These are the essential IDNs for the Generic Device Profile. Every Type 19 device shall contain these parameter.

This class includes the following IDNs:

- S-0-0017 IDN-list of all operation data
- S-0-0099 Reset class 1 diagnostic
- S-0-0390 Diagnostic number
- S-0-1300.x.03 Vendor Code
- S-0-1300.x.05 Vendor Device ID
- S-0-1301 List of GDP classes & Version
- S-0-1302.x.01 FSP Type & Version
- S-0-1302.x.02 Function groups

C.3.3 GDP_DiagT

These are the essential IDNs for the Generic Device Profile, class Diagnosis Trace. If this class is announced the sub-device shall implement this parameter and the dedicated functions.

This class includes the following IDNs:

- S-0-1303.0.02 Diagnostic trace control
- S-0-1303.0.03 Diagnostic trace state
- S-0-1303.0.10 Diagnostic trace buffer no1
- S-0-1303.0.11 Diagnostic trace buffer no2

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- S-0-1305.0.01 Type 19 current time

C.3.4 GDP_DiagTAdv

These are the essential IDNs for the Generic Device Profile, class Diagnosis Trace Advanced. This class requires the implementation of the class GDP_DiagT. If this class is announced the sub-device shall implement this parameter and the dedicated functions.

This class includes the following IDNs:

- S-0-1303.0.01 Diagnostic trace configuration
- S-0-1303.0.12 Diagnostic trace buffer no3

C.3.5 GDP_LNg

These are the essential IDNs for the Generic Device Profile, class LaNguage. If this class is announced the sub-device shall implement this parameter and the dedicated functions.

This class includes the following IDNs:

- S-0-0265 Language selection
- S-0-0266 List of available languages

C.3.6 GDP_PWD

These are the essential IDNs for the Generic Device Profile, class PassWorD. If this class is announced the sub-device shall implement this parameter and the dedicated functions.

This class includes the following IDNs:

- S-0-0267 Password
- S-0-0279 IDN list of password protected data

C.3.7 GDP_Id

These are the essential IDNs for the Generic Device Profile, class Identification. If this class is announced the sub-device shall implement this parameter and the dedicated functions.

This class includes the following IDNs:

- S-0-1300.x.01 Component Name
- S-0-1300.x.02 Vendor Name
- S-0-1300.x.04 Device Name
- S-0-1300.x.11 Order Number
- S-0-1300.x.12 Serial Number
- S-0-1302.x.03 Application Type

C.3.8 GDP_Rev

These are the essential IDNs for the Generic Device Profile, class Revisions. If this class is announced the sub-device shall implement this parameter and the dedicated functions.

This class includes the following IDNs:

- S-0-1300.x.07 Function Revision
- S-0-1300.x.08 Hardware Revision
- S-0-1300.x.09 Software Revision

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- S-0-1300.x.10 Firmware Loader Revision

C.3.9 GDP_QA

These are the essential IDNs for the Generic Device Profile, class Quality Assurance. If this class is announced the sub-device shall implement this parameter and the dedicated functions.

This class includes the following IDNs:

- S-0-1300.x.13 Manufacturing Date
- S-0-1300.x.14 QA Date
- S-0-1300.x.21 Service Date
- S-0-1300.x.22 Calibration Date
- S-0-1300.x.23 Calibration Due Date

C.3.10 GDP_CKs

These are the essential IDNs for the Generic Device Profile, class Checksum. If this class is announced the sub-device shall implement this parameter and the dedicated functions.

This class includes the following IDNs:

- S-0-0192 IDN-list of all backup operation data
- S-0-0531 Checksum for backup operation data

C.3.11 GDP_CKsUser

These are the essential IDNs for the Generic Device Profile, class ChecKsumsUser. This class requires the implementation of the class GDP_CKs. If this class is announced the sub-device shall implement this parameter and the dedicated functions. These parameters may be instantiated by using the instances (SI).

This class includes the following IDNs:

- S-0-0326.x.0 Parameter Checksum
- S-0-0327.x.0 IDN list of checksum parameter

C.3.12 GDP_StM

These are the essential IDNs for the Generic Device Profile, class StateMachine. If this class is announced the sub-device shall implement this parameter and the dedicated functions.

This class includes the following IDNs:

- S-0-0420 Activate parametrization level procedure command (PL)
- S-0-0422 Exit parameterization level procedure command
- S-0-0423 IDN-list of invalid data for parameterization level
- S-0-0425 Sub-device state machine control

C.3.13 GDP_BKP

These are the essential IDNs for the Generic Device Profile, class BacKuP. If this class is announced the sub-device shall implement this parameter and the dedicated functions.

This class includes the following IDNs:

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- S-0-0192 IDN-list of all backup operation data
- S-0-0262 Load defaults procedure command
- S-0-0263 Load working memory procedure command
- S-0-0264 Backup working memory procedure command
- S-0-0531 Checksum for backup operation data

C.3.14 GDP_BKPAdv

These are the essential IDNs for the Generic Device Profile, class BacKuPAdvance. This class requires the implementation of the class GDP_BKP. If this class is announced the sub-device shall implement this parameter and the dedicated functions.

This class includes the following IDNs:

- S-0-0270 IDN list of selected backup operation data
- S-0-0293 Selectively backup working memory procedure command
- S-0-1310 IDN List of operation data changed from default

C.3.15 GDP_RST

These are the essential IDNs for the Generic Device Profile, class Restart. If this class is announced the sub-device shall implement this parameter and the dedicated functions.

This class includes the following IDNs:

- S-0-1350 Reboot Device

C.3.16 GDP_CIPSafetyDev

These are the essential IDNs for the Generic Device Profile, class CIP_SafetyDev. If this class is announced the sub-device shall implement this parameter and the dedicated functions.

C.4 List of all GPD related IDNs

C.4.1 IDN specification

See Clause A.1.

C.4.2 Identification numbers in numerical orders

Table C.3 lists the IDNs which are related to the GDP, and that devices of this type shall support.

Application-specific data content is specified in other relevant standards, for example IEC 61800-7-20x.

Table C.3 – List of relevant communication-related IDNs

IDN (N°)	Name
S-0-0000	Dummy IDN
S-0-0017	IDN-list of all operation data
S-0-0025	IDN-list of all procedure commands
S-0-0095	Diagnostic message
S-0-0099	Reset class 1 diagnostic

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IDN (N°)	Name
S-0-0192	IDN-list of all backup operation data
S-0-0262	Load defaults procedure command
S-0-0263	Load working memory procedure command
S-0-0264	Backup working memory procedure command
S-0-0265	Language selection
S-0-0266	List of available languages
S-0-0267	Password
S-0-0269	Storage mode
S-0-0270	IDN list of selected backup operation data
S-0-0279	IDN list of password protected data
S-0-0293	Selectively backup working memory procedure command
S-0-0326.x.0	Parameter checksum
S-0-0327.x.0	IDN list of Parameter checksum
S-0-0390	Diagnostic number
S-0-0420	Activate parametrization level procedure command (PL)
S-0-0422	Exit parameterization level procedure command
S-0-0423	IDN-list of invalid data for parameterization level
S-0-0425	Sub-device state machine control
S-0-0531	Checksum for backup operation data
S-0-1300.x.1	Component Name
S-0-1300.x.2	Vendor Name
S-0-1300.x.3	Vendor Code
S-0-1300.x.4	Device Name
S-0-1300.x.5	Vendor Device ID
S-0-1300.x.6	Connected to sub-device
S-0-1300.x.7	Function revision
S-0-1300.x.8	Hardware Revision
S-0-1300.x.9	Software Revision
S-0-1300.x.10	Firmware Loader Revision
S-0-1300.x.11	Order number
S-0-1300.x.12	Serial Number
S-0-1300.x.13	Manufacturing date
S-0-1300.x.14	QA Date
S-0-1300.x.20	Operational hours
S-0-1300.x.21	Service Date
S-0-1300.x.22	Calibration Date
S-0-1300.x.23	Calibration Due Date
S-0-1301	List of GDP function groups & Version
S-0-1302.x.1	FSP Type & Version
S-0-1302.x.2	Function groups
S-0-1302.x.3	Application Type
S-0-1303.0.1	Diagnosis trace configuration
S-0-1303.0.2	Diagnosis trace control

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IDN (N°)	Name
S-0-1303.0.3	Diagnosis trace state
S-0-1303.0.10	Diagnosis trace buffer no1
S-0-1303.0.11	Diagnosis trace buffer no2
S-0-1303.0.12	Diagnosis trace buffer no3
S-0-1305.0.1	Current time
S-0-1305.0.2	Current fine time
S-0-1310	IDN List of operation data changed from default
S-0-1399	Test IDN Diagnostic Event

C.4.3 Detailed specification of communication-related IDNs

C.4.3.1 IDN S-0-0000 Dummy IDN

C.4.3.1.1 Attributes

Table C.4 shows the possible attributes for this IDN.

Table C.4 – Attributes of IDN S-0-0000

Attribute	Value
Name	Dummy IDN
Version	—
Length	2
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Never
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.1.2 Description

The usage of this parameter maybe

- a placeholder in a IDN configuration list
- a placeholder of two octets in a connection
- to switch off allocated functions

C.4.3.2 IDN S-0-0017 IDN-list of all operation data

C.4.3.2.1 Attributes

Table C.5 shows the possible attributes for this IDN.

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Table C.5 – Attributes of IDN S-0-0017

Attribute	Value
Name	IDN-list of all operation data
Version	—
Length	4, variable (list sorted by IDN)
Display Format	IDN
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	always
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.2.2 Description

All IDNs of all procedure commands and parameters of the sub-device are stored in this IDN list.

C.4.3.3 IDN S-0-0025 IDN-list of all procedure commands

C.4.3.3.1 Attributes

Table C.6 shows the possible attributes for this IDN.

Table C.6 – Attributes of IDN S-0-0025

Attribute	Value
Name	IDN-list of all procedure commands
Version	—
Length	4, variable (list sorted by IDN)
Display Format	IDN
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.3.2 Description

The IDNs of all procedure commands are stored in this IDN-list.

C.4.3.4 IDN S-0-0095 Diagnostic message

C.4.3.4.1 Attributes

Table C.7 shows the possible attributes for this IDN.

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Table C.7 – Attributes of IDN S-0-0095

Attribute	Value
Name	Diagnostic message
Version	—
Length	1, variable
Display Format	Text
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.4.2 Description

The currently relevant operating status is being monitored with diagnostic messages. The diagnostic messages are generated by the slave as a text and stored in the operation data of this IDN.

C.4.3.5 IDN S-0-0099 Reset class 1 diagnostics

C.4.3.5.1 Attributes

Table C.8 shows the possible attributes for this IDN.

Table C.8 – Attributes of IDN S-0-0099

Attribute	Value
Name	Reset class 1 diagnostics
Version	—
Length	2
Display Format	Binary
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.5.2 Description

If this procedure command is received by the sub-device via the service channel, then all diagnostic events with the class error (C1D), the error bits and the shut-down mechanism are deleted. If the cause of an diagnostic event with the class "error" is still active, then the corresponding event will be generated again. Thus an additional entry for this event within the diagnostic trace has to be generated.

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This procedure command is not interruptible and generates no negative acknowledgment even if an error cannot be deleted or no error exists in the sub-device.

C.4.3.6 IDN S-0-0192 IDN-list of all backup operation data

C.4.3.6.1 Attributes

Table C.9 shows the possible attributes for this IDN.

Table C.9 – Attributes of IDN S-0-0192

Attribute	Value
Name	IDN-list of all backup operation data
Version	—
Length	4, variable (list sorted by IDN)
Display Format	IDN
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.6.2 Description

The IDN-list stores IDNs of all device parameter that have to be loaded in the device in order to guarantee correct operation. The master uses this list to generate a backup copy of the device parameters.

C.4.3.7 IDN S-0-0262 Load defaults procedure command

C.4.3.7.1 Attributes

Table C.10 shows the possible attributes for this IDN.

Table C.10 – Attributes of IDN S-0-0262

Attribute	Value
Name	Load defaults procedure command
Version	—
Length	2
Display Format	Binary
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	OL
Conversion factor	1
Scaling/resolution	1
Unit	—

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C.4.3.7.2 Description

When the master sets and enables the load defaults procedure command, the default parameter values will be activated. The scope and contents of the default parameter values (for example limit values, velocity loop settings, etc.) are determined by the device supplier. The default parameter values are not optimized for the respective application. Therefore the default parameter values allow a problem free inter operation between the sub-device and its connected components.

C.4.3.8 IDN S-0-0263 Load working memory procedure command

C.4.3.8.1 Attributes

Table C.11 shows the possible attributes for this IDN.

Table C.11 – Attributes of IDN S-0-0263

Attribute	Value
Name	Load working memory procedure command
Version	—
Length	2
Display Format	Binary
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	OL
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.8.2 Description

When the master sets and enables the Load working memory procedure command, all data necessary for operation (see S-0-0192) will be loaded from the device's nonvolatile memory into its "active memory". After power on, the device automatically transfers the data from non-volatile memory into the active memory.

NOTE This procedure command will cause active parameters to be overwritten.

C.4.3.9 IDN S-0-0264 Backup working memory procedure command

C.4.3.9.1 Attributes

Table C.12 shows the possible attributes for this IDN.

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Table C.12 – Attributes of IDN S-0-0264

Attribute	Value
Name	Backup working memory procedure command
Version	—
Length	2
Display Format	Binary
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Never
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.9.2 Description

When the master sets and enables the Backup working memory procedure command, all data necessary for operation (see S-0-0192) will be loaded from the device's "active memory" into its non-volatile memory.

NOTE This procedure command will cause previously saved parameters to be overwritten.

C.4.3.10 IDN S-0-0265 Language selection

C.4.3.10.1 Attributes

Table C.13 shows the possible attributes for this IDN.

Table C.13 – Attributes of IDN S-0-0265

Attribute	Value
Name	Language selection
Version	—
Length	2
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Never
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.10.2 Description

This parameter can be used to select one of the languages available in the device (see S-0-0266). By changing the language selection, text from the device such as

- Name (element 2)
- Unit (element 4) and

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- all parameter with data type and display format = text (for example S-0-0095)

will be displayed in the selected language (see Table C.14).

Table C.14 – Language codes

Value	Language
0	German
1	English
2	French
3	Spanish
4	Italian
5	Portuguese
6	Polish
7	Hungarian
8	Russian
9	Swedish
10	Danish
11	Norwegian
12-65535	(reserved)

C.4.3.11 IDN S-0-0266 List of available languages

C.4.3.11.1 Attributes

Table C.15 shows the possible attributes for this IDN.

Table C.15 – Attributes of IDN S-0-0266

Attribute	Value
Name	List of available languages
Version	—
Length	2, variable
Display Format	Unsigned decimal (Language codes see S-0-0165)
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	always
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.11.2 Description

This list contains codes for all languages currently available in the device for language selection (see S-0-0265). This list is required if the device cannot manage or save all languages in its memory simultaneously.

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C.4.3.12 IDN S-0-0267 Password

C.4.3.12.1 Attributes

Table C.16 shows the possible attributes for this IDN.

Table C.16 – Attributes of IDN S-0-0267

Attribute	Value
Name	Password
Version	—
Length	1, variable
Display Format	Text
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Never
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.12.2 Description

This parameter is used to write protect selected parameters of the device by means of a password.

The parameters, which are affected by this kind of write protection, are listed in S-0-0279 IDN list of password protected data.

The password, which is used for the write protection underlies the following rules:

- it shall include only the UTF8 characters
- spaces (UTF8 code 0x20) are not allowed
- the character recognition is case sensitive

The state machine of the write protection of all password protected parameters is illustrated in Figure C.3.

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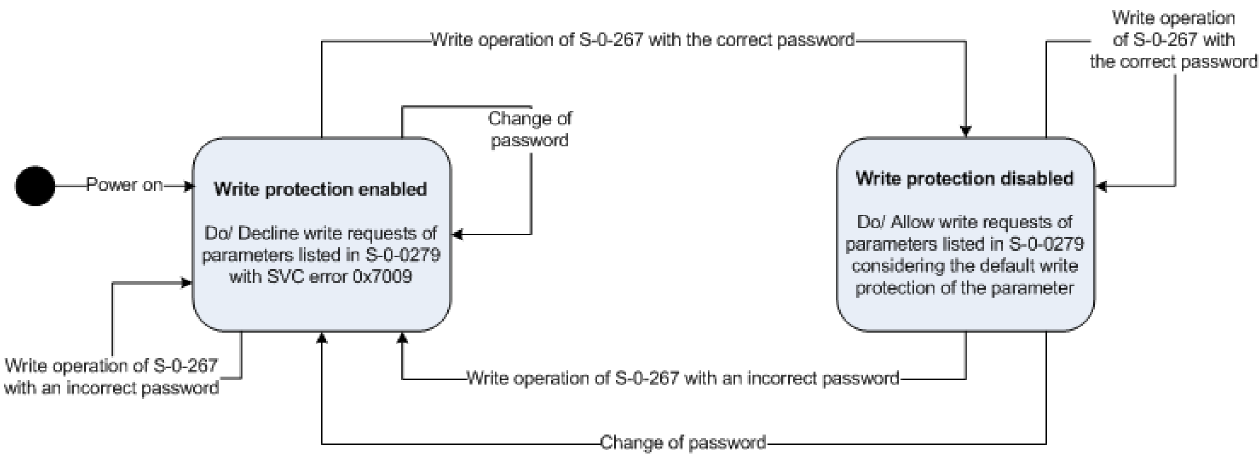

Figure C.3 – Password State Machine

The states can be described as follows (see Table C.17):

Table C.17 – States of the password state machine

State	Description
Write protection enabled	Write requests of parameters listed in S-0-0279 IDN list of password protected data and write requests of the parameter S-0-0279 IDN list of password protected data are declined with SVC error 0x7009 - Operation data is password write-protected. If the operation data of S-0-0267 Password is read in this state, the device will not return the password in plain text. The string "***" (UTF8 code 0x2A) will be sent instead.
Write protection disabled	Write requests of parameters listed in S-0-0279 IDN list of password protected data considering the default write protection of the parameter are possible. This means, that a write request of a parameter, which is write protected in CP4 and listed in S-0-0279 IDN list of password protected data is possible in a communication phase < CP4 but fails in CP4. If the operation data of S-0-0267 Password is read in this state, the device will not return the password in plain text. The string "$$$" (UTF8 code 0x24) will be sent instead.

The transitions can be described as follows (see Table C.18):

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Table C.18 – Transitions of the password state machine

Transition			Description
Source	Target	Condition	
Write protection enabled	Write protection enabled	Write operation of S-0-0267 Password with an incorrect password	Sending a write request of the operation data of S-0-0267 Password with an incorrect password in the state of enabled password-specific write protection does not change the write protection of the parameters listed in S-0-0279 IDN list of password protected data. The write request shall not be declined by the slave with an SVC error (for example 0x7008 (Invalid operation data)), except boundary conditions of the SVC access (for example length of operation data > maximum length) are violated.
Write protection enabled	Write protection enabled	Change of password	A change of the password (see section below) in the state of enabled password-specific write protection, does not change the write protection of the parameters listed in S-0-0279 IDN list of password protected data.
Write protection enabled	Write protection disabled	Write operation of S-0-0267 Password with the correct password	Sending a write request of the operation data of S-0-0267 Password with the correct password (case sensitive), disables the password-specific write protection of all parameters listed in S-0-0279 IDN list of password protected data.
Write protection disabled	Write protection disabled	Write operation of S-0-0267 Password with the correct password	Sending a write request of the operation data of S-0-0267 Password with the correct password in the state of disabled password-specific write protection does not change the write protection of the parameters listed in S-0-0279 IDN list of password protected data.
Write protection disabled	Write protection enabled	Change of password	A change of the password (see section below) enables the password-specific write protection of all parameters listed in S-0-0279 IDN list of password protected data.
Write protection disabled	Write protection enabled	Write operation of S-0-0267 Password with an incorrect password	Sending a write request of the operation data of S-0-0267 Password with an incorrect password, enables the password-specific write protection of all parameters listed in S-0-0279 IDN list of password protected data. The write request shall not be declined by the slave with an SVC error (for example 0x7008 (Invalid operation data)), except boundary conditions of the SVC access (for example length of operation data > maximum length) are violated

Changing the password

In order to change the password, the current password, the new password, and a second verification of the new password have to be written via the SVC (see Table C.19).

A space character (UTF8 code 0x20) is used to delimit the passwords. The new password and the verification copy must match for the device to accept the change.

Table C.19 – Changing the password

1	2	3	4	5
current password	Space (UTF8 code 0x20)	New password	Space (UTF8 code 0x20)	New password

If the new password does not match the verification copy, the slave shall decline the change request with the SVC error 0x7008 - Invalid operation data.

The current value of the password has to be stored in non-volatile memory.

In the case of an unknown password, a supplier designed master password shall be available to deactivate password write protection.

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This password shall always be available as a current password, in addition to the user specified password.

The device supplier shall provide this or another password in documentation shipped with the device, so that the user is able to set up their own password.

C.4.3.13 IDN S-0-0269 Storage mode

C.4.3.13.1 Attributes

Table C.20 shows the possible attributes for this IDN.

Table C.20 – Attributes of IDN S-0-0269

Attribute	Value
Name	Storage mode
Version	—
Length	2
Display Format	Binary
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Manufacturer-specific
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.13.2 Description

The storage mode parameter (see Table C.21) setting determines whether data received over the service channel (UC channel) is stored temporarily (for example in RAM), or remanent (for example EEPROM). Which parameter are affected by the storage mode setting are to be defined by the device supplier in the device documentation.

Table C.21 – Structure of storage mode

Bit no.	Value	Description
15-1	—	(reserved)
0	—	Storage mode
	0	Data stored remanent
	1	Data stored not remanent

C.4.3.14 IDN S-0-0270 IDN list of selected backup operation data

C.4.3.14.1 Attributes

Table C.22 shows the possible attributes for this IDN.

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Table C.22 – Attributes of IDN S-0-0270

Attribute	Value
Name	IDN list of selected backup operation data
Version	—
Length	4, variable
Display Format	IDN
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Never
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.14.2 Description

This IDN list is used to define a subset of the IDN list of backup operation data (S-0-0192) which should be stored into the non-volatile memory of the sub-device. The selectively backup working memory procedure command (S-0-0293), will only store the operation data of this IDN list into the non-volatile memory.

C.4.3.14.3 IDN S-0-0279 IDN list of password protected data

C.4.3.14.4 Attributes

Table C.23 shows the possible attributes for this IDN.

Table C.23 – Attributes of IDN S-0-0279

Attribute	Value
Name	IDN list of password protected data
Version	—
Length	4, variable (list sorted by IDN)
Display Format	IDN
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Never
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.14.5 Description

The operation data of this IDN contains an IDN list, the operation data of which should be write-protected by means of S-0-0267 (Password).

Since this IDNs list must not be changed by an unauthorized user, this IDN always has to be write protected by means of S-0-0267 (Password), regardless of whether or not this parameter contains its own IDN (S-0-0279) as an entry of the IDN list.

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C.4.3.15 IDN S-0-0293 Selectively backup working memory procedure command

C.4.3.15.1 Attributes

Table C.24 shows the possible attributes for this IDN.

Table C.24 – Attributes of IDN S-0-0293

Attribute	Value
Name	Selectively backup working memory procedure command
Version	—
Length	2
Display Format	Binary
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Never
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.15.2 Description

When the master sets and enables the selectively backup working memory procedure command, all parameter programmed in the IDN list of selected backup operation data (S-0-0270) will be loaded from the device's "active memory" and stored into its non-volatile memory.

NOTE This procedure command will cause previously saved parameters to be overwritten.

C.4.3.16 IDN S-0-0326.x.00 Parameter checksum

C.4.3.16.1 Attributes

Table C.25 shows the possible attributes for this IDN.

Table C.25 – Attributes of IDN S-0-0326.x.00

Attribute	Value
Name	Parameter checksum
Version	—
Length	4
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

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C.4.3.16.2 Description

After being switched on, the control unit is able to find out by comparing, whether the parameters or firmware have changed in the device. The device calculates the parameter checksum, when the IDN is read via the service channel.

For the calculation of the checksum, the parameters which are listed in S-0-0327.x.0 IDN list of checksum parameter are used. If S-0-0327.x.0 is not supported by the device, the IDN list S-0-0192 IDN-list of all backup operation data is taken for the checksum calculation.

C.4.3.17 IDN S-0-0327.x.00 IDN list of checksum parameter

C.4.3.17.1 Attributes

Table C.26 shows the possible attributes for this IDN.

Table C.26 – Attributes of IDN S-0-0327.x.00

Attribute	Value
Name	IDN list of checksum parameter
Version	—
Length	4, variable (list sorted by IDN)
Display Format	IDN
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Never
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.17.2 Description

This IDN-list contains all ident numbers for the calculation of the parameter checksum. see S-0-0326.x.0 Parameter Checksum.

C.4.3.18 IDN S-0-0390 Diagnostic number

C.4.3.18.1 Attributes

Table C.27 shows the possible attributes for this IDN.

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Table C.27 – Attributes of IDN S-0-0390

Attribute	Value
Name	Diagnostic number
Version	—
Length	4
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.18.2 Description

The operation data of this IDN contains detailed information about the diagnostic event with the highest priority which is currently active within the slave or sub-device.

In order to make this information language independent, a 16 bit status code is used to identify the specific diagnostic event. Using the status code, the operator interface has the ability to display diagnostic message text in languages which are not supported by the sub-device.

The prioritization of diagnostic events is described in Table C.28.

Table C.28 – Prioritization of diagnostic events

Diagnosis class (Bits 16-19)	Priority	Signaled (1)	Overwritten (2)
operational state	Priority 4 (lowest)	As long as relevant for presentation (for example until overwritten by the next information with the class operational state).	By any other diagnostic information with a higher priority. By diagnostic information with the same priority, which occurs subsequently.
procedure command specific state	Priority 3	As long as the procedure command is not reset by the master.	By any other diagnostic information with a higher priority. By diagnostic information with the same priority, which occurs subsequently.
warning (C2D)	Priority 2	As long as the corresponding threat is present.	By any other diagnostic information with a higher priority.
error (C1D)	Priority 1 (highest)	As long as S-0-0099 Reset class 1 diagnostic has not been executed after the cause for the corresponding failure has been removed	-

(1) Signaled – The diagnostic information is part of the operation data

(2) Overwritten – The corresponding diagnostic information is overwritten by other diagnostic information

If a diagnostic event gets inactive and there are no more active diagnostic events the operation data of this IDN has to contain the status code 0x0000.

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A summary of all specified status codes are shown in the S-0-0390.

The structure of the diagnostic number is shown in Table C.29.

Table C.29 – Transitions of the password state machine

Bit no.	Value	Description
31-30	—	Interpretation of bits 29-0 (The bits 31-30 defines the interpretation of groups source type, class and status codes.)
	00	manufacturer specific status codes (bits 29-24 type and class defined by Type 19, bits 15-0 status codes defined by manufacturer)
	01	fully manufacturer specific (bits 29-0 are defined by manufacturer)
	10	(reserved)
	11	Standard (bits 29-0 are defined by Type 19)
29-24	—	Source type
	0x00	FSP Drive
	0x01	FSP IO
	0x02	GDP
	0x03	SCP
	0x04	CSoS
	0x05	FSP Encoder
	0x06	Safety Application
	0x07 … 0x3E	(reserved)
	0x3F	Unknown
23-20	—	(reserved)
19-16	—	Class
	0x00-0x09	(reserved)
	0x0A	Operational state (Priority 4 lowest) - Is used to inform about operational state related messages or other information (for example Drive HALT, Compatible replacement).
	0x0B	(reserved)
	0x0C	procedure command specific state (Priority 3) - Is used to inform about diagnostic events which occur during the execution of a procedure command.
	0x0D	(reserved)
	0x0E	Warning (C2D) – Priority 2
	0x0F	Error (C1D) – Priority 1 (highest)
15-00	—	Status code

C.4.3.19 IDN S-0-0420 Activate parametrization level procedure command (PL)

C.4.3.19.1 Attributes

Table C.30 shows the possible attributes for this IDN.

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Table C.30 – Attributes of IDN S-0-0420

Attribute	Value
Name	Activate parametrization level procedure command (PL)
Version	—
Length	2
Display Format	Binary
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Never
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.19.2 Description

By activating this procedure command the master instructs the sub-device to change from the operating level (OL) to the parameterization level (PL).

If the procedure command cannot be executed at this time, the sub-device generates the SVC error message 0x7012 - "Procedure command at this time not executable".

- The procedure command is acknowledged positively by the slave:
- After the sub-device state machine is decoupled from the communication state machine
- The sub-device has activated PL
- Bit 4 (Sub-device level) of the Device Status word has been set to 1 (parameterization level (PL) is active).

C.4.3.20 IDN S-0-0422 Exit parameterization level procedure command

C.4.3.20.1 Attributes

Table C.31 shows the possible attributes for this IDN.

Table C.31 – Attributes of IDN S-0-0422

Attribute	Value
Name	Exit parameterization level procedure command
Version	—
Length	2
Display Format	Binary
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Never
Conversion factor	1
Scaling/resolution	1
Unit	—

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C.4.3.20.2 Description

By activating this procedure command the master instructs the sub-device to change from the parameterization level (PL) to the operating level (OL).

After the activation of this procedure command the slave checks all corresponding parameters and turns all monitoring systems on. Necessary references shall be recovered by the control unit (for example by homing).

The procedure command is acknowledged positively by the sub-device:

- After the sub-device state machine is decoupled from the communication state machine
- After the sub-device has activated OL
- Bit 4 (Sub-device level) of the Device Status word has been set to 0 (operating level (OL) is active).
- When all corresponding parameters are checked without faults
- When the monitoring system has been switched on

The procedure command is acknowledged negatively if a fault has appeared during the checks. In this case all IDNs which have caused a fault are stored in the IDN list (S-0-0423) and the sub-device remains in parameterization level.

C.4.3.21 IDN S-0-0423 IDN-list of invalid data for parameterization level

C.4.3.21.1 Attributes

Table C.32 shows the possible attributes for this IDN.

Table C.32 – Attributes of IDN S-0-0423

Attribute	Value
Name	IDN-list of invalid data for parameterization level
Version	—
Length	4, variable
Display Format	IDN
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.21.2 Description

This IDN contains all IDNs which are considered as invalid by the sub-device during procedure command S-0-0422 (Exit parameterization level procedure command).

If the procedure command S-0-0422 is executed successfully the process data contains no IDNs.

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C.4.3.22 IDN S-0-0425 Sub-device state machine control

C.4.3.22.1 Attributes

Table C.33 shows the possible attributes for this IDN.

Table C.33 – Attributes of IDN S-0-0425

Attribute	Value
Name	Sub-device state machine control
Version	—
Length	2
Display Format	Binary
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Never
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.22.2 Description

Table C.34 shows the structure of the sub-device state machine control.

Table C.34 – Structure of the sub-device state machine control

Bit no.	Value	Description
15-1	—	(reserved)
0	—	Decoupling state
	0	Coupled (The sub-device state machine is coupled with the communication state machine)
	1	Decoupled (The sub-device state machine shall be decoupled from the communication state machine. A transition of the communication state machine does not lead to a transition of the sub-device state machine.)

C.4.3.23 IDN S-0-0531 Dummy IDN

C.4.3.23.1 Attributes

Table C.35 shows the possible attributes for this IDN.

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Table C.35 – Attributes of IDN S-0-0531

Attribute	Value
Name	Checksum for backup operation data
Version	—
Length	4
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.23.2 Description

The device calculates the checksum when the IDN is read via the service channel.

For the calculation of the checksum, the parameters which are saved in S-0-0192 are used.

C.4.3.24 IDN S-0-1300.x.1 Component Name

C.4.3.24.1 Attributes

Table C.36 shows the possible attributes for this IDN.

Table C.36 – Attributes of IDN S-0-1300.x.1

Attribute	Value
Name	Component Name
Version	—
Length	1, variable
Display Format	Text
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	—
Unit	—

C.4.3.24.2 Description

The content of this IDN is manufacturer specific and contains the component name depending to the device, for example, motor, amplifier, power supply, bus coupler. The contents may be used for display purpose only.

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C.4.3.25 IDN S-0-1300.x.2 Vendor Name

C.4.3.25.1 Attributes

Table C.37 shows the possible attributes for this IDN.

Table C.37 – Attributes of IDN S-0-1300.x.2

Attribute	Value
Name	Vendor Name
Version	—
Length	1, variable
Display Format	Text
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	—
Unit	—

C.4.3.25.2 Description

This IDN contains the vendor name of the device.

C.4.3.26 IDN S-0-1300.x.3 Vendor Code

C.4.3.26.1 Attributes

Table C.38 shows the possible attributes for this IDN.

Table C.38 – Attributes of IDN S-0-1300.x.3

Attribute	Value
Name	Vendor Code
Version	—
Length	2
Display Format	unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	—
Unit	—

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C.4.3.26.2 Description

The vendor code (see Table C.39) is a unique number assigned to each vendor and helps identifying a Type 19 device installed in the Type 19 network. The vendor shall apply for the vendor-code at the sercos user organisation.

Table C.39 – Vendor code

Value	Description
0x0000	Unregistered vendors
Other values	Registered vendors

C.4.3.27 IDN S-0-1300.x.4 Device Name

C.4.3.27.1 Attributes

Table C.40 shows the possible attributes for this IDN.

Table C.40 – Attributes of IDN S-0-1300.x.4

Attribute	Value
Name	Device Name
Version	—
Length	1, variable
Display Format	Text
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	—
Unit	—

C.4.3.27.2 Description

The content of this IDN is manufacturer specific and identifies the device name published in vendor's price list.

C.4.3.28 IDN S-0-1300.x.5 Vendor Device ID

C.4.3.28.1 Attributes

Table C.41 shows the possible attributes for this IDN.

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Table C.41 – Attributes of IDN S-0-1300.x.5

Attribute	Value
Name	Vendor Device ID
Version	—
Length	1, variable
Display Format	Text
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	—
Unit	—

C.4.3.28.2 Description

The vendor device ID is a unique device ID managed by the vendor and identifies the component number.

C.4.3.29 IDN S-0-1300.x.6 Connected to sub-device

C.4.3.29.1 Attributes

Table C.42 shows the possible attributes for this IDN.

Table C.42 – Attributes of IDN S-0-1300.x.6

Attribute	Value
Name	Connected to sub-device
Version	—
Length	2
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	—
Unit	—

C.4.3.29.2 Description

If a device holds more than one sub-device and the component is assigned to a specific sub-device the operational data shows the assigned slave number.

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C.4.3.30 IDN S-0-1300.x.7 Function revision

C.4.3.30.1 Attributes

Table C.43 shows the possible attributes for this IDN.

Table C.43 – Attributes of IDN S-0-1300.x.7

Attribute	Value
Name	Function revision
Version	—
Length	2
Display Format	Unsigned decimal
Min. input value	0
Max. input value	9999
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	—
Unit	—

C.4.3.30.2 Description

The function revision shall be adjusted on the case of functional corrections of this component. The manufacturer of the device guarantees the compatibleness. The function revision shall not to be checked on system startup.

C.4.3.31 IDN S-0-1300.x.8 Hardware Revision

C.4.3.31.1 Attributes

Table C.44 shows the possible attributes for this IDN.

Table C.44 – Attributes of IDN S-0-1300.x.8

Attribute	Value
Name	Hardware Revision
Version	—
Length	1, variable
Display Format	Text
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	—
Unit	—

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C.4.3.31.2 Description

This parameter contains the hardware revision of the device, therefore it can be used for the identification. The hardware revision includes the software revision S-0-1300.x.09 if it is not supported by the device. The hardware revision is specified by the manufacturer (for example 103).

C.4.3.32 IDN S-0-1300.x.9 Software Revision

C.4.3.32.1 Attributes

Table C.45 shows the possible attributes for this IDN.

Table C.45 – Attributes of IDN S-0-1300.x.9

Attribute	Value
Name	Software Revision
Version	—
Length	1, variable
Display Format	Text
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	—
Unit	—

C.4.3.32.2 Description

This parameter contains the software or firmware version of the device, therefore it can be used for the identification. The software revision is specified by the manufacturer.

C.4.3.33 IDN S-0-1300.x.10 Firmware Loader Revision

C.4.3.33.1 Attributes

Table C.46 shows the possible attributes for this IDN.

Table C.46 – Attributes of IDN S-0-1300.x.10

Attribute	Value
Name	Firmware Loader Revision
Version	—
Length	1, variable
Display Format	Text
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1

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Attribute	Value
Scaling/resolution	—
Unit	—

C.4.3.33.2 Description

This parameter contains the firmware loader or boot loader revision which is implemented in the device. The firmware loader revision is specified by the manufacturer.

C.4.3.34 IDN S-0-1300.x.11 Order number

C.4.3.34.1 Attributes

Table C.47 shows the possible attributes for this IDN.

Table C.47 – Attributes of IDN S-0-1300.x.11

Attribute	Value
Name	Order number
Version	—
Length	1, variable
Display Format	Text
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	—
Unit	—

C.4.3.34.2 Description

This parameter contains the order number of the device, therefore it can be used for the identification. The customer needs the order number to order this certain device. The order number is specified by the manufacturer.

C.4.3.35 IDN S-0-1300.x.12 Serial Number

C.4.3.35.1 Attributes

Table C.48 shows the possible attributes for this IDN.

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Table C.48 – Attributes of IDN S-0-1300.x.12

Attribute	Value
Name	Serial Number
Version	—
Length	1, variable
Display Format	Text
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	—
Unit	—

C.4.3.35.2 Description

This parameter contains the serial number of the device, therefore it can be used for the identification. The serial number is defined and assigned by the manufacturer that uniquely identifies each individual device (for example 1234567890).

C.4.3.36 IDN S-0-1300.x.13 Manufacturing date

C.4.3.36.1 Attributes

Table C.49 shows the possible attributes for this IDN.

Table C.49 – Attributes of IDN S-0-1300.x.13

Attribute	Value
Name	Manufacturing date
Version	—
Length	1, variable
Display Format	Text
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	always
Conversion factor	1
Scaling/resolution	—
Unit	—

C.4.3.36.2 Description

This IDN contains the manufacturing date and time of the component (see Figure C.4). The information is provided by a text string formatted as described within ISO 8601 (extended format):

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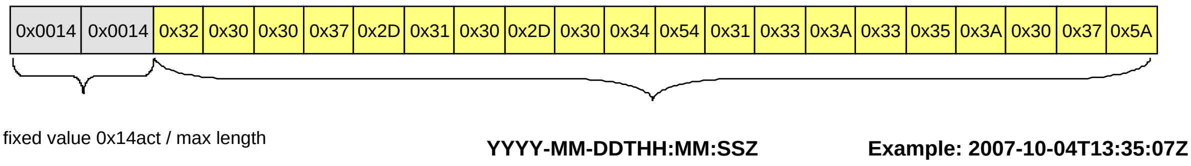

Figure C.4 – Structure of Date information

Date information is separated by hyphen "-" and time information by colon ":". Date and time are divided by a "T" character. The resulting text is terminated with Z (time zone UTC) with a fixed length of 20 characters.

C.4.3.37 IDN S-0-1300.x.14 QA Date

C.4.3.37.1 Attributes

Table C.50 shows the possible attributes for this IDN.

Table C.50 – Attributes of IDN S-0-1300.x.14

Attribute	Value
Name	QA Date
Version	—
Length	1, variable
Display Format	Text
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	—
Unit	—

C.4.3.37.2 Description

This IDN contains the date and time when the quality assurance test has been performed for this component (see Figure C.5). Quality assurance is one of the final product test to ensure that the product keeps the desired quality level.

The information is provided by a text string formatted as described within ISO 8601 (extended format):

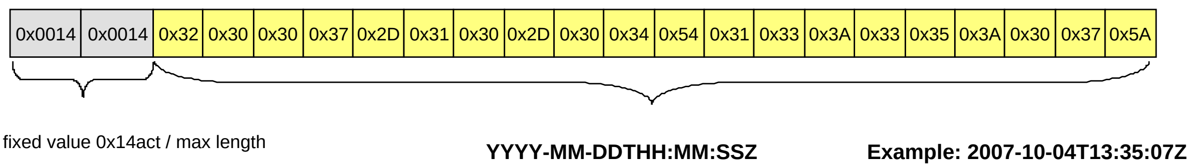

Figure C.5 – Structure of QA date information

Date information is separated by hyphen "-" and time information by colon ":". Date and time are divided by a "T" character. The resulting text is terminated with Z (time zone UTC) with a fixed length of 20 characters.

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C.4.3.38 IDN S-0-1300.x.20 Operational hours

C.4.3.38.1 Attributes

Table C.51 shows the possible attributes for this IDN.

Table C.51 – Attributes of IDN S-0-1300.x.20

Attribute	Value
Name	Operational hours
Version	—
Length	4
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1 h
Unit	h

C.4.3.38.2 Description

This parameter contains the operational hours of the component. The device shall store this data in a retain memory.

C.4.3.39 IDN S-0-1300.x.21 Service Date

C.4.3.39.1 Attributes

Table C.52 shows the possible attributes for this IDN.

Table C.52 – Attributes of IDN S-0-1300.x.21

Attribute	Value
Name	Service Date
Version	—
Length	1, variable
Display Format	Text
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

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C.4.3.39.2 Description

This IDN contains the date and time of the last service maintenance for the device, for example firmware update (see Figure C.6).

The information is provided by a text string formatted as described within ISO 8601 (extended format):

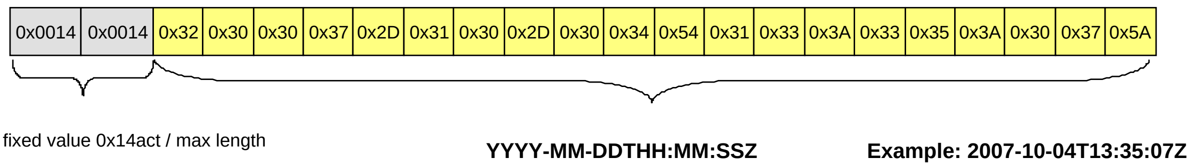

Figure C.6 – Structure of Service date information

Date information is separated by hyphen "-" and time information by colon ":". Date and time are divided by a "T" character. The resulting text is terminated with Z (time zone UTC) with a fixed length of 20 characters.

C.4.3.40 IDN S-0-1300.x.22 Calibration Date

C.4.3.40.1 Attributes

Table C.53 shows the possible attributes for this IDN.

Table C.53 – Attributes of IDN S-0-1300.x.22

Attribute	Value
Name	Calibration Date
Version	—
Length	1, variable
Display Format	Text
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Never
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.40.2 Description

This IDN contains the date and time of the last calibration of the device (see Figure C.7). A service engineer shall write the current date and time into this IDN after a calibration service is done. At the same time, the date and time of the next required calibration date shall be written to S-0-1300.x.23.

The information is provided by a text string formatted as described within ISO 8601 (extended format):

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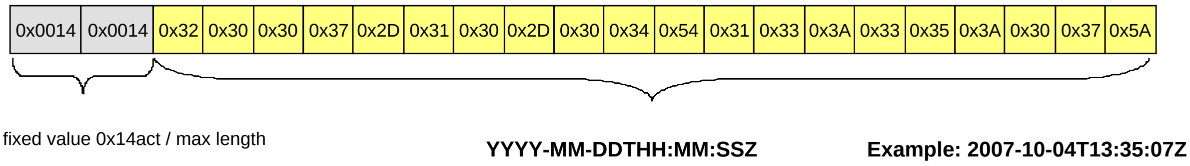

Figure C.7 – Structure of Calibration date information

Date information is separated by hyphen "-" and time information by colon ":". Date and time are divided by a "T" character. The resulting text is terminated with Z (time zone UTC) with a fixed length of 20 characters.

C.4.3.41 IDN S-0-1300.x.23 Calibration Due Date

C.4.3.41.1 Attributes

Table C.54 shows the possible attributes for this IDN.

Table C.54 – Attributes of IDN S-0-1300.x.23

Attribute	Value
Name	Calibration Due Date
Version	—
Length	1, variable
Display Format	Text
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Never
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.41.2 Description

This IDN contains the date and time of the next calibration service of the device (see Figure C.8). After a service engineer has performed a calibration, the current date and time shall be written to S-0-1300.x.22 and the date and time of the next required calibration date shall be written to this IDN.

The information is provided by a text string formatted as described within ISO 8601 (extended format):

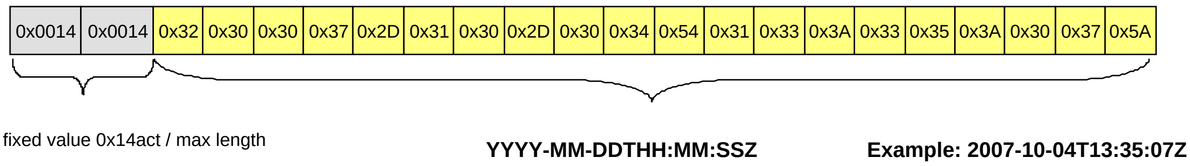

Figure C.8 – Structure of Calibration due date information

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Date information is separated by hyphen "-" and time information by colon ":". Date and time are divided by a "T" character. The resulting text is terminated with Z (time zone UTC) with a fixed length of 20 characters.

C.4.3.42 IDN S-0-1301 List of GDP classes & Version

C.4.3.42.1 Attributes

Table C.55 shows the possible attributes for this IDN.

Table C.55 – Attributes of IDN S-0-1301

Attribute	Value
Name	List of GDP classes & Version
Version	—
Length	2, variable
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.42.2 Description

This parameter contains a list of the generic profile capabilities and the dedicated versions of the sub-device (see Table C.56).

- The bits 15 ... 8 indicate the GDP class,
- bits 7 ... 4 are reserved,
- bits 3 ... 0 indicate the version of this GDP class.

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Table C.56 – Structure of GDP classes & version

Class Code Bits 15-8	Reserved Bits 7-4	Version Bits 3-0	Class name	Description
0x00	0x0	0x1	—	Not used
0x01	0x0	0x1	GDP_Basic	The generic profile shall be supported by each sub-device
0x02	0x0	0x1	GDP_Id	Identification
0x03	0x0	0x1	GDP_QS	Quality System
0x04	0x0	0x1	GDP_Rev	Revision
0x05	0x0	0x1	GDP_LNg	Language
0x06	0x0	0x1	GDP_StM	State Machine
0x07	0x0	0x1	GDP_CKs	Checksum
0x08	0x0	0x1	GDP_CKsUser	Checksum User
0x09	0x0	0x1	GDP_BKP	Backup
0x0A	0x0	0x1	GDP_BKPAdv	Backup Advanced
0x0B	0x0	0x1	GDP_DiagT	Diagnosis Trace
0x0C	0x0	0x1	GDP_DiagTAdv	Diagnosis Trace Advanced
0x0D	0x0	0x1	GDP_PWD	Password
0x0E-0xF	0x0	0x1	(reserved)	For future extensions
0x10	0x0	0x1	GDP_RST	Restart
0x11	0x0	0x1	GDP_CIPSafetyDev	CIP Safety Device
0x12-0xFF	0xn	0xn	(reserved)	For future extensions

C.4.3.43 IDN S-0-1302.x.1 FSP Type & Version

C.4.3.43.1 Attributes

Table C.57 shows the possible attributes for this IDN.

Table C.57 – Attributes of IDN S-0-1302.x.1

Attribute	Value
Name	FSP Type & Version
Version	—
Length	4
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	always
Conversion factor	1
Scaling/resolution	1
Unit	—

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C.4.3.43.2 Description

The FSP Type & Version indicates the function specific type and the function dependent version of the resource as shown in Table C.58.

Table C.58 – Coding of S-1302.x.01

Bit No.	Value	Description
31	—	P/S
	0	Defined by Type 19
	1	Defined by manufacturer
30-16	—	Type 19 FSP types
	0x00	(reserved)
	0x01	FSP IO
	0x02	FSP Drive
	0x03	FSP Encoder
	0x04-0x7FFF	(reserved)
15-0	—	Version
	0x0000	(reserved)
	0x0001	First version

C.4.3.44 IDN S-0-1302.x.2 Function groups

C.4.3.44.1 Attributes

Table C.59 shows the possible attributes for this IDN.

Table C.59 – Attributes of IDN S-0-1302.x.2

Attribute	Value
Name	Function groups
Version	—
Length	4, variable (list sorted by SI)
Display Format	IDN
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.44.2 Description

The operation data of this IDN contains a list of all instanced function groups.

This IDN is only present in case of a modular structured device according to for example FSP_IO. In case of a resource FSP IO this IDN is a list of IO function groups of FSP_IO. The elements of this list contain IDNs. The structure instance shows the slot number of the module (structure instance = module position), the structure element (SE) is always = 0. If the

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leftmost component is the bus coupler this list starts with the FG bus coupler (S-0-1500 .0.0). Otherwise the list starts with the leftmost IO-module at slot number 1, for example S-0-15xx.1.0. If a module contains more than one IO function group every IO function group has to be designated.

The mapping of data into the container InputData S-0-1500.x.09 and container OutputData S-0-1500.x.05 occurs in sequence of the list entries (see Figure C.9).

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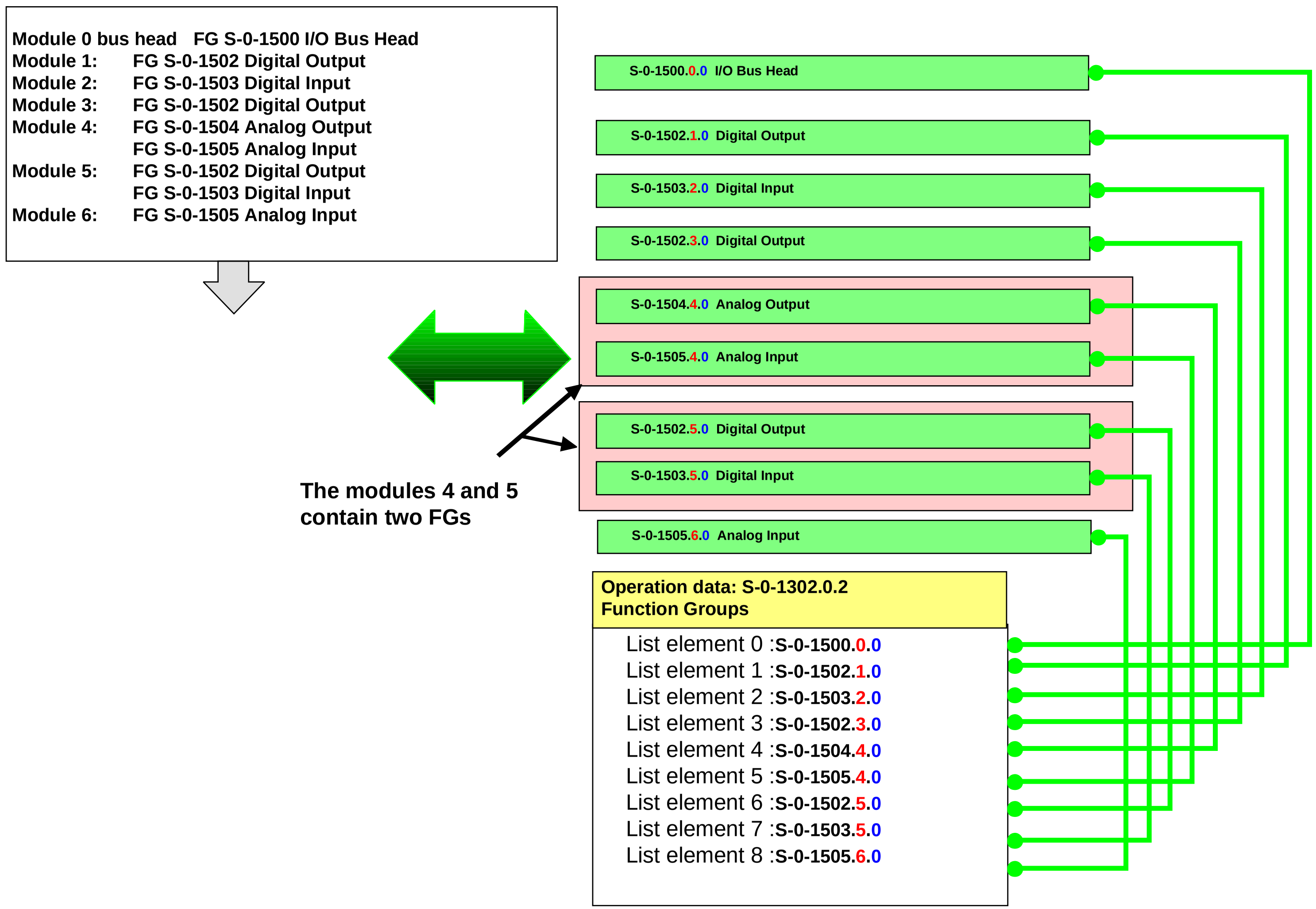

Figure C.9 – Mapping of data into the InputData and OutputData container

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C.4.3.45 IDN S-0-1302.x.3 Application Type

C.4.3.45.1 Attributes

Table C.60 shows the possible attributes for this IDN.

Table C.60 – Attributes of IDN S-0-1302.x.3

Attribute	Value
Name	Application Type
Version	—
Length	1, variable
Display Format	Text
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Never
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.45.2 Description

The operation data of the application type contains the type of the sub-device application (for example: main spindle drive, round axis, X axis, etc.) The user can program this parameter if desired.

C.4.3.46 IDN S-0-1303.0.1 Diagnosis trace configuration

C.4.3.46.1 Attributes

Table C.61 shows the possible attributes for this IDN.

Table C.61 – Attributes of IDN S-0-1303.0.1

Attribute	Value
Name	Diagnosis trace configuration
Version	—
Length	4, variable
Display Format	IDN
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

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C.4.3.46.2 Description

The IDN S-0-1303.0.01 describes the configured extension of the diagnosis trace listed in S-0-1303.0.12 to S-0-1303.0.127. This IDN shows a list of the additional IDNs which are added to the diagnosis trace in the same sequence (for example S-0-1500.x.33 Current IO Diagnosis Message in case of FSP IO).

The contents of IDN S-0-1303.0.01 are defined by the manufacturer.

C.4.3.47 IDN S-0-1303.0.2 Diagnosis trace control

C.4.3.47.1 Attributes

Table C.62 shows the possible attributes for this IDN.

Table C.62 – Attributes of IDN S-0-1303.0.2

Attribute	Value
Name	Diagnosis trace control
Version	—
Length	2
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Not defined
Conversion factor	1
Scaling/resolution	—
Unit	—

C.4.3.47.2 Description

This parameter controls the Diagnosis trace flow as shown in Table C.63.

Table C.63 – Coding of S-1303.0.02

Bit number	Value	Description
15	—	organization (master commands the organization of diagnosis buffer)
	0	Ring
	1	List
14-8	—	(reserved)
7-4	—	Threshold of Diagnosis class corresponds to Bits 19..16 S-0-0390 only diagnosis with classes equal or higher will be captured
3-2	—	(Reserved)
1		Reset buffer (The buffer is deleted and at the same time the status information. If the Level Indicator is supported, it is set to 1.)
0	—	Recording
	0	Capture (Diagnostic trace is capturing diagnostic events.)
	1	Freeze (Diagnostic trace does not capture any diagnostic events. Hence a consistent evaluation of the diagnostic buffers is possible.)

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C.4.3.48 IDN S-0-1303.0.3 Diagnosis trace state

C.4.3.48.1 Attributes

Table C.64 shows the possible attributes for this IDN.

Table C.64 – Attributes of IDN S-0-1303.0.3

Attribute	Value
Name	Diagnosis trace state
Version	—
Length	2
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	always
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.48.2 Description

This parameter shows the state of the diagnosis trace flow as shown in Table C.65.

Table C.65 – Coding of S-1303.0.2

Bit number	Value	Description
15	—	organization (shows the organization of the buffer)
	0	ring (trace flow is organized as a ring)
	1	list (trace flow is organized as a list)
14-4	—	(reserved)
3	—	Overrun, indicates that the diagnostic trace buffer has been exceeded, i.e. – in case of a list new entries are lost, – in case of a ring old entries are overwritten.
	0	overrun has not occurred
	1	overrun has occurred
2-1	—	level indicator
	3	Full (Indicates that the diagnostic trace buffer is full but has not overrun yet.)
	2	Filled (Indicates that the diagnostic trace buffer contains at least one entry.)
	1	Empty (Indicates that the diagnostic trace buffer contains no entries.)
	0	— indicator level not present
0	—	Recording
	0	Capture
	1	Freeze

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C.4.3.49 IDN S-0-1303.0.10 Diagnosis trace buffer no1

C.4.3.49.1 Attributes

Table C.66 shows the possible attributes for this IDN.

Table C.66 – Attributes of IDN S-0-1303.0.10

Attribute	Value
Name	Diagnosis trace buffer no1
Version	—
Length	4, variable
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	unit of the parameter

C.4.3.49.2 Description

This parameter contains a row of the diagnosis trace. The information is organized as a ring buffer or list.

Within this buffer each diagnostic event which occurs within the sub-device is recorded in form of the S-0-0390 (Diagnostic Number).

An event which is recorded within the diagnosis trace does not necessarily has to be indicated via S-0-0390 (Diagnostic Number) due to diagnostic priority reasons

C.4.3.50 IDN S-0-1303.0.11 Diagnosis trace buffer no2

C.4.3.50.1 Attributes

Table C.67 shows the possible attributes for this IDN.

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Table C.67 – Attributes of IDN S-0-1303.0.11

Attribute	Value
Name	Diagnosis trace buffer no2
Version	—
Length	8, variable
Display Format	Type 19 time
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	Unit of the parameter

C.4.3.50.2 Description

This parameter contains a row of the diagnosis trace, and contains information organized as a ring buffer or list. The configuration is fixed to Type 19 current time S-0-1305.0.01 of the related diagnostic number.

C.4.3.51 IDN S-0-1303.0.12 Diagnosis trace buffer no3

C.4.3.51.1 Attributes

Table C.68 shows the possible attributes for this IDN.

Table C.68 – Attributes of IDN S-0-1303.0.12

Attribute	Value
Name	Diagnosis trace buffer no3
Version	—
Length	Length of parameter, variable
Display Format	Format of parameter
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	Unit of parameter

C.4.3.51.2 Description

This parameter contains a row of the diagnosis trace, and contains information organized as a ring buffer or list. The configuration is fixed to Type 19 current time S-0-1305.0.01 of the related diagnostic number. This IDN shows the next row of diagnosis trace.

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C.4.3.52 IDN S-0-1305.0.1 Type 19 current time

C.4.3.52.1 Attributes

Table C.69 shows the possible attributes for this IDN.

Table C.69 – Attributes of IDN S-0-1305.0.1

Attribute	Value
Name	Type 19 current time
Version	—
Length	8
Display Format	Type 19 time
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Never
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.52.2 Description

This parameter contains the current Type 19 time in IEC 61588 format (Table C.70). The sub-device shall mark events with this time (for example S-0-1305.0.01 Type 19 current time marks the S-0-1303 Diagnostic trace with time stamps).

This parameter shall become active within start-up of the device with the initial value of 0 indicating that Type 19 current time has not been set.

The IEC has determined that the value = 0x0 corresponds to 1970-01-01, 00:00, 0 s, 0 ns.

If SCP_SysTime is activated in the slave, then this parameter shall be written protected in CP3 and CP4.

Table C.70 – Structure of Type 19 time

Bit no.	Value	Description
63-32		Seconds
31-0		Nanoseconds

C.4.3.53 IDN S-0-1305.0.2 Type 19 current fine time

C.4.3.53.1 Attributes

Table C.71 shows the possible attributes for this IDN.

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Table C.71 – Attributes of IDN S-0-1305.0.2

Attribute	Value
Name	Type 19 current fine time
Version	—
Length	4
Display Format	Unsigned decimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Never
Conversion factor	1
Scaling/resolution	0,001 µs
Unit	µs

C.4.3.53.2 Description

This parameter contains the low 32 bit of the current Type 19 time in IEC 61588 format. The sub-device may use this to mark events with this time.

If SCP_SysTime is activated in the slave, then this parameter shall be write protected in CP3 and CP4.

C.4.3.54 IDN S-0-1310 IDN-list of operation data changed from default

C.4.3.54.1 Attributes

Table C.72 shows the possible attributes for this IDN.

Table C.72 – Attributes of IDN S-0-1310

Attribute	Value
Name	IDN-list of operation data changed from default
Version	—
Length	4, variable
Display Format	IDN
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Always
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.54.2 Description

This IDN list is managed by the device and contains a list of all IDN's which operation data is changed from default.

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C.4.3.55 IDN S-0-1350 Reboot Device

C.4.3.55.1 Attributes

Table C.73 shows the possible attributes for this IDN.

Table C.73 – Attributes of IDN S-0-1350

Attribute	Value
Name	Reboot device
Version	—
Length	2
Display Format	binary
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	OL
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.55.2 Description

The master uses this procedure command to initialize a reboot of the whole device.

- If S-0-1350.0.1 Reboot Device Delay exists, the device waits for the time period, which is defined in S-0-1350.0.1, before the reboot is performed.
- If S-0-1350.0.1 Reboot Device Delay does not exist, the device waits for min. 2 seconds and max. 30 seconds before the reboot is performed. This gives the master the possibility to reboot several devices in the ring.

NOTE The reboot of a device leads to the fact that the Type 19 communication is interrupted and the communication phase up has to be performed again.

C.4.3.56 IDN S-0-1399.0.1 Test IDN Diagnostic Event

C.4.3.56.1 Attributes

Table C.74 shows the possible attributes for this IDN.

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Table C.74 – Attributes of IDN S-0-1310

Attribute	Value
Name	Test IDN Diagnostic Event
Version	—
Length	4
Display Format	Hexadecimal
Min. input value	—
Max. input value	—
Positions after decimal point	0
Write protection	Never
Conversion factor	1
Scaling/resolution	1
Unit	—

C.4.3.56.2 Description

Writing this IDN causes an application specific diagnostic event within the sub-device (Table C.75). The virtually caused diagnostic shall be treated within the sub-device as a real diagnostic event. That means that the virtually caused diagnostic event has an impact on all supported Type 19 diagnostic mechanisms which are amongst others (not a complete list):

Communication Profile (SCP)

- S-0-0014 (Interface Status)
- S-0-1028 (Error counter MST-P/S)
- S-0-1035.0.0 (Error counter Port1 and Port2)
- S-0-1045 (Device Status (S-DEV))
- S-0-1050.x.08 (Connection Control)
- S-0-1050.x.12 (Error Counter Data Losses)

Generic Device Profile (GDP)

- S-0-0095 (Diagnostic Message)
- S-0-0390 (Diagnostic Number)
- S-0-1303 (Diagnostic Trace)
- Type 19 LED

Function Specific Profile Drive (FSP Drive)

- S-0-0011 (Class 1 diagnostic (C1D))
- S-0-0012 (Class 2 diagnostic (C2D))
- S-0-0135 (Drive Status)

Function Specific Profile IO (FSP IO)

- S-0-1500.x.02 (IO Status)
- S-0-1500.x.32 (IO Diagnostic Message)
- IO_FG.x.17 (DIAGIN) (manufacturer specific)

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The structure of the operation data of this IDN is almost identical to the operation data of the S-0-0390 (Diagnostic Number) (except bits 30-31). Writing this IDN with bit 31 set shall cause a diagnostic event with the source type, class and source code specified within the operation data.

Furthermore diagnostic events caused by this IDN shall be resettable by writing this IDN containing the diagnostic event which should be reset and bit 31 set to 0.

Table C.75 – Structure of Test IDN Diagnostic Event

Bit no.	Value	Description
31	—	Activation level (The bit 31 defines whether the diagnostic event is activated or deactivated.)
	0	Deactivation of the diagnostic event (Writing the IDN with this bit set to 0 deactivates the corresponding diagnostic event within the slave)
	1	Activation of the diagnostic event (Writing the IDN with this bit set activates the corresponding diagnostic event within the slave)
30	—	Interpretation the status code (The bit 30 defines the interpretation of the status code)
	0	manufacturer specific status codes (Bits 15-0 status codes defined by manufacturer)
	1	Standard (Status codes are defined by Type 19)
29-24		Source type (The encoding is identical to S-0-0390 (Diagnostic Number) Bits 24-29)
23-20		(reserved)
19-16		Class (The encoding is identical to S-0-0390 Diagnostic Number Bits 16-19)
15-0		Status code

C.5 GDP status codes

The following article defines the status codes for the GDP, which are used for the language-neutral presentation of diagnostic information of Type 19 slave devices.

The status codes, which are listed in Table C.76 and Table C.77, are grouped into different categories according to their fix assigned diagnosis class.

Table C.76 – Status codes with the diagnosis class "operational state"

Code (hex)	Description
A010	The device has been restarted (Power on)
A100	Wrong password entered
A110	Password write protection deactivated
A120	Password changed
A200	Diagnostic trace started
A210	Diagnostic trace stopped
A220	Diagnostic trace buffer overrun
A300	Test IDN written

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Table C.77 – Status codes with the diagnosis class "procedure command specific state"

Code (hex)	Description
200	S-0-0422 Exit parameterization level procedure command
201	Incorrect or incomplete set of parameters (see S-0-0423 IDN-list of invalid data for parameterization level)
202	Parameter limit violation (see S-0-0423 IDN-list of invalid data for parameterization level)
203	Parameter conversion error (see S-0-0423 IDN-list of invalid data for parameterization level)
400	S-0-0420 Activate parametrization level procedure command (PL)
401	Switching to parametrization level is not possible
500	S-0-0099 Reset class 1 diagnostic
700	S-0-0262 Load defaults procedure command
2200	S-0-0264 Backup working memory procedure command
2300	S-0-0263 Load working memory procedure command
2400	S-0-0293 Selectively backup working memory procedure command

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[1] At present, these subparts are IEC 61800-7-201, IEC 61800-7-202, IEC 61800-7-203 and IEC 61800-7-204.

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

RÉSEAUX DE COMMUNICATION INDUSTRIELS – SPÉCIFICATIONS DES BUS DE TERRAIN –

Partie 4-19: Spécification du protocole de la couche liaison de données – Eléments de type 19

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NOTE Les combinaisons de types de protocoles sont spécifiées dans la CEI 61784-1 et la CEI 61784-2.

La Norme internationale CEI 61784-4-19 a été établie par le sous-comité 65C: Réseaux industriels, du comité d'études 65 de la CEI: Mesure, commande et automation dans les processus industriels.

Cette troisième édition annule et remplace la deuxième édition parue en 2010. Cette édition constitue une révision technique.

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Les modifications majeures par rapport à l'édition précédente sont énumérées ci-dessous:

- introduction de connexions établies sur un modèle producteur-consommateur;
- introduction de mécanismes supplémentaires destinés à réaliser des fonctionnalités telles que l'horodatage et le sur-échantillonnage;
- amélioration des caractéristiques de connexion à chaud et de redondance;
- amélioration de la commutation des phases et de la gestion des erreurs;
- améliorations rédactionnelles.

Le texte de cette norme est issu des documents suivants:

FDIS	Rapport de vote
65C/762/FDIS	65C/772/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme.

Cette publication a été rédigée selon les Directives ISO/CEI, Partie 2.

Une liste de toutes les parties de la série CEI 61158, publiées sous le titre général *Réseaux de communication industriels – Spécifications des bus de terrain*, peut être consultée sur le site web de la CEI.

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INTRODUCTION

La présente partie de la CEI 61158 fait partie d'une série élaborée pour faciliter l'interconnexion des composants de systèmes d'automatisation. Elle est apparentée à d'autres normes dans l'ensemble, comme défini par le modèle de référence de bus de terrain ”à trois couches” décrit dans la CEI 61158-1.

Le protocole de liaison de données assure un service de liaison de données en s’appuyant sur les services offerts par la couche physique. La présente norme a pour principal objet de préciser un ensemble de règles de communication, exprimées sous la forme de procédures qu'ont à suivre les entités de liaison de données (DLE) homologues au moment de la communication. Ces règles de communication ont pour vocation de fournir une base de développement stable visant à atteindre différents objectifs:

a) guider les ingénieurs d'application et les concepteurs;
b) réaliser les essais et acquérir l’équipement;
c) dans le cadre d’un accord d’intégration des systèmes dans l’environnement de systèmes ouverts;
d) dans le cadre d’une meilleure compréhension des communications prioritaires au sein de l’OSI.

La présente norme porte en particulier sur la communication et l’interfonctionnement des capteurs, des effecteurs et d’autres appareils d’automatisation. Grâce à la présente norme associée à d’autres normes des modèles de référence OSI ou de bus de terrain, des systèmes par ailleurs incompatibles peuvent fonctionner ensemble, quelle que soit leur combinaison.

NOTE L’attention est attirée sur le fait que l’utilisation de certains types de protocole associés est limitée par leurs détenteurs de droit à la propriété intellectuelle. Dans tous les cas, l'engagement pris par les détenteurs quant à une diffusion limitée desdits droits de propriété intellectuelle permet d'utiliser un type particulier de protocole de couche liaison de données avec des protocoles de couche physique et de couche application dans les combinaisons de types explicitement spécifiées dans les séries de profils. L'utilisation des divers types de protocoles dans d'autres combinaisons peut nécessiter une autorisation de la part de leurs détenteurs de droits à la propriété intellectuelle respectifs.

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RÉSEAUX DE COMMUNICATION INDUSTRIELS – SPÉCIFICATIONS DES BUS DE TERRAIN –

Partie 4-19: Spécification du protocole de la couche liaison de données – Eléments de type 19

1 Domaine d'application

1.1 Généralités

La couche liaison de données assure les communications de messagerie prioritaires de base entre les appareils d’un environnement d’automatisation.

Ce protocole offre à toutes les entités de liaison de données participantes

a) des opportunités de communication cyclique à démarrage synchrone, selon un ordre préétabli, et

b) de manière asynchrone cyclique ou acyclique, tel que requis à chaque cycle par chacune de ces entités de liaison de données.

Ainsi, ce protocole peut être caractérisé comme un protocole qui offre un accès cyclique et acyclique asynchrone, mais avec un redémarrage synchrone de chaque cycle.

1.2 Spécifications

La présente norme spécifie

a) les procédures de transfert opportun des données et des informations de commande entre une entité utilisateur de liaison de données et une entité utilisateur homologue, et parmi les entités de liaison de données formant le fournisseur de service de liaison de données distribué;

b) la structure des DLPDU de bus de terrain utilisée par le protocole de la présente norme pour le transfert des données et des informations de commande, et leur représentation sous forme d’unités de données d’interface physique.

1.3 Procédures

Les procédures sont définies en termes

a) d’interactions entre les entités DL (DLE) homologues par l’échange de DLPDU de bus de terrain;

b) d’interactions entre un fournisseur de service DL (DLS) et un utilisateur DLS au sein du même système par l’échange de primitives DLS;

c) d’interactions entre un fournisseur DLS et un fournisseur de service Ph au sein du même système par l’échange de primitives de service Ph.

1.4 Applicabilité

Ces procédures s’appliquent aux instances de communication entre des systèmes qui prennent en charge des services de communications prioritaires dans la couche liaison de données des modèles de référence OSI ou de bus de terrain, et qui peuvent être connectés dans un environnement d’interconnexion de systèmes ouverts.

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1.5 Conformité

La présente norme spécifie également les exigences de conformité relatives aux systèmes mettant en œuvre ces procédures. La présente partie de la CEI 61158 ne comporte aucun essai visant à démontrer la conformité à ces exigences.

2 Références normatives

Les documents suivants sont cités en référence de manière normative, en intégralité ou en partie, dans le présent document et sont indispensables pour son application. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

NOTE Toutes les parties de la série CEI 61158, ainsi que la CEI 61784-1 et la CEI 61784-2 font l'objet d'une maintenance simultanée. Les références croisées à ces documents dans le texte se rapportent par conséquent aux éditions datées dans la présente liste de références normatives.

CEI 61158-4-16:2007, *Réseaux de communication industriels – Spécifications des bus de terrain – Partie 4-16: Spécification de protocole de la couche liaison de données – Eléments de type 16*

ISO/CEI 7498-1, *Technologies de l'information – Interconnexion de systèmes ouverts (OSI) – – Partie 1: Modèle de référence de base: Le modèle de base*

ISO/CEI 7498-3, *Technologies de l'information – Interconnexion de systèmes ouverts (OSI) – – Partie 3: Modèle de référence de base: Dénomination et adressage*

ISO/IEC 8802-3, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications* (disponible en anglais seulement)

ISO 8601, *Éléments de données et formats d'échange – Échange d'information – Représentation de la date et de l'heure*

IEEE 802.3: *IEEE Standard for Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications*

Internet Engineering Task Force (IETF), *Request for Comments (RFC): RFC 879, The TCP Maximum Segment Size and Related Topics* (disponible à l'adresse <http://www.ietf.org/rfc/rfc0879.txt>)

3 Termes, définitions, symboles, acronymes, abréviations et conventions

Pour les besoins du présent document, les termes, définitions, symboles, abréviations et conventions suivants s'appliquent.

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3.1 Termes et définitions du modèle de référence

La présente norme repose en partie sur les concepts développés dans l'ISO/CEI 7498-1 et ISO/CEI 7498-3, et utilise les termes suivants.

3.2 Termes et définitions supplémentaires de Type 19

Pour les besoins du présent document, les termes et définitions suivants s'appliquent.

3.2.1
diffusion
transmission à tous les appareils du réseau sans acquittement par les récepteurs

3.2.2
cycle de communication
période de temps fixe entre deux télégrammes de synchronisation maîtres au cours de laquelle des télégrammes en temps réel sont transmis sur le canal RT et des télégrammes en temps différé sont transmis sur le canal IP

3.2.3
unité de commande
appareil de commande (par exemple, un automate programmable selon les spécifications de la série CEI 61131)

3.2.4
mot de commande
deux octets adjacents, au sein du télégramme de données maître, contenant des commandes destinées à l'appareil adressé

3.2.5
communication croisée
transfert direct de données multidiffusion entre des appareils

3.2.6
durée de cycle
durée d'un cycle de communication

3.2.7
transmission cyclique
échange périodique de télégrammes

3.2.8
données cycliques
partie d'un télégramme dont la signification ne change pas pendant le fonctionnement cyclique du réseau

3.2.9
fonctionnement cyclique
fonctionnement au cours duquel les appareils du réseau de communication sont adressés et interrogés l'un après l'autre, à intervalles de temps fixes et constants

3.2.10
appareil
esclave situé dans le réseau de communication (par exemple, entraînement électrique de puissance selon les définitions de la série CEI 61800, station d'E/S selon la série CEI 61131)

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3.2.11
champ d'adresse d'appareil
code adresse (huit bits) contenant l'adresse de l'appareil

3.2.12
commande d'appareil
quatre octets adjacents dans le télégramme de données maître contenant les commandes de chaque appareil

3.2.13
état d’appareil
quatre octets adjacents du télégramme d'acquittement qui contiennent des informations d'état sur chaque appareil

3.2.14
identifiant de station DLE
adresse réseau attribuée à une DLE

3.2.15
emplacement de station DLE
unité (granularité de un) de mapping dépendant de la position (pour un champ de données cycliques) dont une DLE peut occuper un ou plusieurs emplacements, délimités par l'intervalle dont le début est l'identifiant de station DLE, sa longueur étant égale au nombre configuré d'emplacements occupés

3.2.16
élément
partie des IDN - chaque IDN comporte 7 éléments, chacun de ces éléments ayant une signification spécifique (par exemple, numéro, nom, données)

3.2.17
EtherType
partie de l'en-tête de télégramme spécifique de Type 19

3.2.18
acheminement
mode de transmission d'un appareil sur un télégramme reçu à destination de l'autre port, qu'il soit modifié ou non

3.2.19
numéro d'identification
IDN (identification number)
désignation de données d'exploitation sous laquelle un bloc de données est conservé avec son attribut, son nom, son unité, ses valeurs d'entrée minimale et maximale, et les données

3.2.20
ligne,
structure linéaire
topologie de réseau dans laquelle le moyen de transmission s'effectue de station en station en forme de ligne; l'information est transmise dans une direction descendante entre le maître et le dernier esclave de la ligne, puis revient vers le maître via tous les esclaves dans l'ordre inverse (CP 16/3)

3.2.21
bouclage
mode de transmission d'un appareil sur un télégramme reçu à destination du même port et de l'autre port, qu'il soit modifié ou non

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3.2.22
maître
nœud qui autorise les autres nœuds (c'est-à-dire les esclaves) à transmettre

3.2.23
télégramme de données maître
MDT (master data telegram)
télégramme dans lequel le maître intègre ses données

3.2.24
DLE maître
DLE qui exécute les fonctions du maître de réseau

3.2.25
télégramme de synchronisation maître
MST (master synchronisation telegram)
télégramme, ou partie de télégramme, dans lequel/laquelle le maître intègre un signal de synchronisation temporelle

3.2.26
télégramme MDT0
télégramme dans lequel le maître transmet aux esclaves ses données de synchronisation et tout ou partie de ses données en temps réel

3.2.27
participant
nœud qui est connecté au réseau

3.2.28
couche physique
première couche du modèle de référence ISO-OSI

3.2.29
protocole
convention à l'égard des formats de données, des suites chronologiques et de la correction d'erreurs dans le cadre de l'échange de données des systèmes de communication

3.2.30
données en temps réel
partie de télégramme dont la signification ne change pas pendant le fonctionnement cyclique de l'interface

3.2.31
canal RT
intervalle de temps défini inclus dans le cycle de communication, qui transmet les télégrammes en temps réel CPF16

3.2.32
voie de service
SVC (service channel)
transmission en temps différé de l'information sur demande du maître au cours de l'intervalle de temps RT

3.2.33
esclave
nœud auquel le maître accorde le droit de transmettre des données

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3.2.34
DLE esclave
DLE qui exécute les fonctions de l'esclave de réseau

3.2.35
station
nœud qui est connecté au réseau

3.2.36
mot d'état
deux octets adjacents dans le télégramme d'acquittement contenant les informations d'état d'un appareil

3.2.37
S-0-nnnn
désignation des IDN

3.2.38
télégramme
DLPDU

3.2.39
topologie
architecture de réseau physique relative à la connexion entre les stations du système de communication

3.2.40
index de topologie
position d’un esclave dans un réseau de Type 19 utilisant une numération en série commençant avec la valeur 1 attribuée au premier esclave après le maître

3.3 Symboles

ADR	adresse d'appareil (device address) (1 ≤ ADR ≤ 511) ajustée directement sur l'appareil, par exemple, en utilisant un sélecteur
MST AT	en-tête de l'AT
AT0...3	télégrammes d'acquittement (acknowledge telegrams)
INFO	information de voie de service
JtScyc	instabilité intégrée à tScyc
MDT0	télégramme de données maître (master data telegram) avec les données de synchronisation évaluées par l'esclave)
MDT1...3	télégrammes de données maître (master data telegram) sans données de synchronisation)
P1	port 1
P2	port 2
RxD	données reçues
SLKN	paramètre d'identification de l'esclave, disposition de l'esclave

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SVC	voie de service (service channel)
t1	temps de début de transmission de l'AT
t1min	temps de début de transmission de l'AT le plus court
t3	temps de validation de la valeur de commande
t4	temps de départ d'acquisition des données de contrôle par retour
t5	temps minimal de traitement du retour
Tcable	temps de report du signal transmis par le câble, pour chaque unité de longueur (environ 5 ns/m)
Trep	temps de report du signal reçu par un esclave d'acheminement (entrée-sortie)
tRing	temps nécessaire à un télégramme maître pour traverser le réseau et atteindre une nouvelle fois le maître
tScyc	durée du cycle de communication
TxD	données transmises

3.4 Acronymes et abréviations

AHS	protocole de transport de l’appareil (HS d'acquittement)
AT	télégramme d'acquittement (acknowledge telegram)
C-CON	contrôle de connexion (connection control)
C-DEV	commande d’appareil (device control)
C1D	diagnostic de classe 1
CP	phase de communication (communication phase)
CPS	commutation de phase de communication (communication phase switching)
CRC	contrôle de redondance cyclique (cyclic redundancy check)
CSoS	Sécurité CIP sur SERCOS
FCS	séquence de contrôle DLPDU
FG	groupe de fonctions (Function Group)
FSP	profil spécifique à la fonction (Function-specific Profile)
GDP	Profil d’appareil générique (Generic Device Profile)

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HP	connexion à chaud (Hot-Plug)
HP0	phase 0 de connexion à chaud (Hot-Plug phase 0)
HP1	phase 1 de connexion à chaud (Hot-Plug phase 1)
HP2	phase 2 de connexion à chaud (Hot-Plug phase 2)
HS	protocole de voie de service (voir AHS et MHS)
IDN	numéro d'identification (identification number)
IP	protocole Internet (Internet protocol)
MAC	contrôle d'accès au support (Media access control)
MDT	télégramme de données maître (master data telegram)
MST MDT	en-tête de MDT
MHS	protocole de transport du maître
MS	communication esclave-maître
MST	télégramme de synchronisation maître (master synchronization telegram)
NRT	temps différé (non real-time)
P-channel	canal P /canal primaire (primary channel)
P-telegram	télégramme primaire (primary telegram)
PL	niveau de paramétrage (parametrization level)
TR	temps réel (real-time)
RTC	canal en temps réel (real-time channel)
RTD	données en temps réel (real-time data) de MDT ou AT
S-DEV	état d'appareil (device status)
S-channel	canal S/ canal secondaire (secondary channel)
S-telegram	télégramme S/ télégramme secondaire (secondary telegram)
SCH	en-tête de commande de session (session control header)
SCP	profil de communication de Type 19

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SE	élément de structure (structure element)
SERCOS	interface série du système de communication en temps réel
SFD	délimiteur DLPDU de début (start DLPDU delimiter)
SI	Instance de structure (structure instance)
SMP	protocole de messagerie de Type 19
SVC	voie de service (service channel)
UCC	canal de communication unifiée/canal UC (unified communication channel)

3.5 Conventions supplémentaires

Des numéros d'identification (IDN) sont attribués à tous les types de données. Ces numéros comportent des données (commandes et valeurs de retour), paramètres et procédures en temps réel. La plupart des IDN sont semblables à ceux applicables au Type 16 (voir 3.6 de la CEI 61158-4-16). Plusieurs IDN se rapportent à l'application et sont définis dans les normes correspondantes (par exemple, CEI 61800-7-20x pour les Systèmes d'entraînement).

Se reporter à l'Annexe A pour des informations supplémentaires, ainsi qu'à l'Article A.1 de la CEI 61158-4-16 pour une spécification détaillée des IDN.

4 Présentation du protocole DL

4.1 Présentation générale

Ce type de protocole fournit des moyens extrêmement optimisés d'échange de données en temps réel de longueur fixe et de télégrammes segmentés de longueur variable entre un appareil maître unique et un ensemble d'appareils esclaves, interconnectés dans une topologie en anneau ou linéaire. La topologie en anneau prévoit des voies de communication redondantes, et commute automatiquement, en cas d'anomalie, sur un ensemble de deux lignes sans perturber la communication.

Ce type de protocole prévoit également une transmission directe de données en temps réel entre les esclaves, à l'intérieur du canal en temps réel (RTC), au sein de chaque cycle de communication.

L'échange de données en temps réel est totalement synchrone par configuration et n'est pas affecté par le trafic de messagerie.

L'utilisateur fixe les adresses d'appareil, à l'aide d'un sélecteur par exemple. Il est possible d'ajouter des appareils supplémentaires lorsque cela est requis, même en fonctionnement, sans que cela n'affecte la sélection des adresses déjà existantes. La détermination du numéro, de l'identité et des caractéristiques de chaque appareil peut être configurée ou être détectée de manière automatique au démarrage.

Des interfaces esclaves doivent être utilisées pour la connexion des appareils esclaves au réseau. Au niveau de la couche physique, un esclave représente la connexion entre un ou plusieurs appareils au réseau. Logiquement, un esclave présentant plusieurs appareils doit agir de la même manière que plusieurs esclaves présentant chacun un seul appareil.

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Ce type de protocole prévoit également un canal de communication unifiée (canal UC), dans lequel il est possible d'échanger des DLPDU Ethernet standard entre les appareils de Type 19 et les autres nœuds de réseau Ethernet connectés.

Il existe deux classes de DLE de Type 19:

a) DLE maître;
b) DLE esclave.

Seule la DLE maître est capable de déclencher une transmission cyclique.

Les télégrammes de Type 19 sont des DLPDU Ethernet conformément à l'ISO/CEI 8802-3. Les télégrammes en temps réel de Type 19 doivent être transmis dans la partie en temps réel de la durée du cycle de communication. Ils acheminent principalement des données d'entrée et de sortie, par exemple des valeurs de commande et de retour. L'en-tête de Type 19 spécifie deux types de télégrammes de Type 19:

a) Le télégramme de données maître (MDT), dans lequel le maître transmet des données en temps réel aux esclaves;
b) Le télégramme d'acquittement (AT), dans lequel les esclaves transmettent des données en temps réel au maître et aux autres esclaves.

D'autres DLPDU Ethernet peuvent être transmises dans le canal UC.

Le Type 19 spécifie 4 MDT (MDT0 à MDT3). Les MDT doivent être transmis par le maître et reçus par chaque esclave. Ils doivent également contenir toutes les informations (par exemple, synchronisation, valeurs de commande, sorties numériques) transmises du maître aux esclaves par le canal en temps réel.

Les MDT0 doivent toujours être transmis. Les MDT1 à MDT3 doivent être transmis uniquement si cela est nécessaire, selon la configuration des données d’application devant être transmises. Le maître doit toujours transmettre le même nombre de MDT au cours de chaque cycle de communication.

Le Type 19 spécifie 4 AT (AT0 à AT3). Les AT doivent être transmis par le maître avec la longueur AT configurée. Les champs de données AT sont fixés sur 0, sauf les données d’application de la communication croisée. Chaque esclave doit intégrer ses données dans le champ de données qui lui est attribué dans l'AT. Les AT doivent contenir toutes les informations (par exemple, valeurs de retour, entrées numériques) transmises des esclaves au maître, ainsi qu'aux autres appareils esclaves par le canal en temps réel.

Les AT0 doivent toujours être transmis. Les AT1 à AT3 doivent être transmis uniquement si cela est nécessaire, selon la configuration des données d’application devant être transmises. Le maître doit toujours transmettre le même nombre d'AT au cours de chaque cycle de communication.

La configuration des attributions des voies de service (SVC), de la commande d’appareil (C-DEV), de l’état d’appareil (S-DEV) et les connexions dans le MDT ainsi que dans l'AT, doit s'effectuer au moyen de paramètres. Les longueurs des connexions dans les MDT et AT doivent dépendre de la quantité des données d’application et peuvent être différentes pour chaque esclave selon cette même configuration. Le nombre de MDT et d'AT peut également être différent en raison de la configuration. Cette configuration doit satisfaire aux exigences suivantes.

a) Une SVC d'un esclave doit être transmise dans un MDT ou un AT et ne doit pas se répartir en différents MDT ou AT.
b) Une connexion d'un esclave doit être transmise dans un MDT ou un AT et ne doit pas se répartir en deux MDT ou AT différents.

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c) Chaque connexion et chaque SVC doivent commencer à une adresse paire du MDT et de l'AT.

d) Chaque commande d'appareil et chaque état d'appareil doivent commencer à une adresse paire du MDT et de l'AT.

e) Toutes les autres combinaisons de configurations de SVC, connexions, commande d'appareil et état d'appareil sont possibles.

Les appareils dans un réseau de Type 19 utilisent l'ordre du petit-boutiste pour la transmission en série des données. Le petit-boutiste décrit que le bit de poids faible de l'octet de poids faible du mot de poids faible est envoyé en premier, suivi du reste des bits dans cet octet, et puis du reste des octets de ce mot, et ainsi de suite dans le même ordre.

4.2 Identification DLPDU générale

4.2.1 Introduction

Les DLPDU doivent être identifiées comme cela est spécifié dans le Tableau 1.

Tableau 1 – Identification des DLPDU Ethernet

Champ DLPDU	Type de données	Valeur/description
MAC Dest	octet[6]	Adresse MAC de destination
MAC Src	octet[6]	Adresse MAC source
EtherType	WORD	0x88CD (Type 19)

4.2.2 Adresse de destination (MAC Dest)

Le maître doit transmettre des DLPDU à tous les esclaves utilisant l'adresse de diffusion 0xFFFF FFFF FFFF comme adresse de destination.

4.2.3 Adresse source (MAC Src)

L'adresse source doit toujours être l'adresse MAC du maître.

4.2.4 EtherType

Le EtherType pour les DLPDU en temps réel doit contenir la valeur 0x88CD, qui est le seul numéro de champ de type affecté par la IEEE EtherType Field Registration Authority pour les télégrammes de Type 19.

NOTE Ce numéro de champ fait référence à la communication de type 19.

4.3 Structure DLPDU générale

4.3.1 Introduction

La structure des données internes à une DLPDU doit comporter les entrées de données suivantes comme cela est spécifié dans le Tableau 2.

Tableau 2 – Structure des données internes à une DLPDU

Champ de données	Type de données	Valeur/description
En-tête	octet[6]	Définit le type de DLPDU
Charge utile	octet[40-1494]	Les champs de données sont remplis s'ils comportent moins de 40 octets.

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4.3.2 En-tête de DLPDU

Il doit préciser deux types de télégrammes, tels que spécifiés en 4.4:

- **Télégramme de données maître (MDT):** Les MDT doivent transmettre des données du maître aux esclaves;
- **Télégramme d'acquittement (AT):** Les AT doivent transmettre des données des esclaves au maître, ainsi qu'aux autres esclaves dans le réseau de Type 19.

4.3.3 Charge utile DLPDU

Toutes les données transmises peuvent comporter des séquences de bits arbitraires.

Des octets de remplissage doivent être ajoutés si les données de Type 19 comportent moins de 40 octets, afin d'atteindre une longueur de champ de données totale d'au moins 46 octets.

La charge utile DLPDU doit être telle que décrite en 4.5 et 4.6.

4.4 En-tête de DLPDU

4.4.1 Introduction

L'en-tête de la DLPDU doit différencier les différentes DLPDU. Le télégramme doit comporter un codage stipulant si la DLPDU est transmise dans le canal principal ou secondaire, s'il s'agit d'un MDT ou d'un AT et quel type de MDT ou d'AT (MDT0 à MDT3, respectivement AT0 à AT3).

Dans une topologie linéaire, le maître doit déterminer si les télégrammes sont marqués comme des télégrammes principaux ou secondaires, selon la configuration.

La structure d'en-tête de la DLPDU est présentée dans le Tableau 3.

Tableau 3 – En-tête de charge utile DLPDU

Champ de données	Type de données	Valeur/description
Type de DLPDU	octet[1]	voir 4.4.2
Réservé	octet[1]	—
Réservé	octet[4]	—

4.4.2 Type de DLPDU

Le type de DLPDU doit être généré par le maître et transmis dans chaque MDT et AT. Son contenu doit être tel que présenté dans le Tableau 4.

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Tableau 4 – Type de DLPDU

Numéro de bit	Valeur de bit	Description
7	—	Télégramme principal ou secondaire
	0	Télégramme sur le canal principal (télégramme P)
	1	Télégramme sur le canal secondaire (télégramme S)
6	—	MDT ou AT
	0	MDT
	1	AT
5	—	Cycle CNT
	0	Cycle CNT désactivé
	1	Cycle CNT activé (le cycle CNT est défini dans la phase MDT (bit 6-4)
4	—	(réservé)
3-2		(réservé pour le numéro de télégramme 4 à 15)
1-0	—	Numéro de télégramme
	00	Numéro de télégramme 0
	01	Numéro de télégramme 1
	10	Numéro de télégramme 2
	11	Numéro de télégramme 3

4.5 DLPDU MDT

4.5.1 Synthèse de champs MST MDT

Le MDT doit être comme cela est spécifié dans le Tableau 5. L'en-tête de MDT de MDT0 est appelé MST.

Tableau 5 – En-tête de MDT

Elément DLPDU	Champ de données	Type de données	Valeur/description
En-tête de MDT	Type de MDT	octet[1]	voir 4.5.3
	Phase de MDT	octet[1]	voir 4.5.4
	CRC MDT	octet[4]	voir 4.5.5

4.5.2 Evaluation de l'en-tête de MDT dans les esclaves

L'en-tête de MDT doit être généré par le maître et évalué par les esclaves. Chaque esclave doit évaluer l'en-tête de MDT selon le Tableau 6.

Tableau 6 – En-tête de MDT à prendre en compte par l'esclave

	Type de MDT	Phase de MDT	CRC MDT
MDT0 = MST	Oui	Oui	Oui
MDT1	Oui	Non	Oui
MDT2	Oui	Non	Oui
MDT3	Oui	Non	Oui

NOTE L'esclave n'est tenu d'évaluer le type et la phase de MDT que si le CRC MDT est valide.

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4.5.3 Type de MDT

Se reporter à 4.4.2, où le bit #6 doit être égal à 0.

4.5.4 Phase de MDT

La phase de MDT doit contenir l'état de la communication de Type 19 pendant l'initialisation et au cours de la phase CP4. La phase doit être générée par le maître et transmise dans chaque MDT. La structure est présentée dans le Tableau 7.

Tableau 7 – Phase de MDT

Numéro de bit	Valeur de bit	Description
7	—	Commutation de phase de communication (CPS)
	0	CP actuelle La phase de communication (bit 3-0) contient la CP actuelle.
	1	Nouvelle CP La phase de communication (bit 3-0) contient la CP cible pour la commutation de phase.
6-4	—	Cycle CNT (doit être activé dans le type de DLPDU MDT, le bit 5 est réglé sur 1)
	0-7	Valeur du Cycle CNT (est augmenté de 1 par le maître dans chaque cycle de communication)
3-0	—	Phase de communication (CP)
	0000	CP0
	0001	CP1
	0010	CP2
	0011	CP3
	0100	CP4
	0101 à 1111	(réservé)

4.5.5 CRC MDT

Le contrôle de redondance cyclique (CRC) doit être utilisé par les algorithmes de transmission et de réception pour générer une valeur CRC dédiée au champ CRC MDT. Ce champ doit contenir une valeur de contrôle de redondance cyclique (CRC) de 4 octets (32 bits). Cette valeur doit être calculée en fonction du contenu de l'adresse de destination (voir 4.2.2), de l'adresse source (voir 4.2.3), de l'EtherType (voir 4.2.4), du Type 19 (voir 4.4.2) et de la phase (voir 4.5.4). Le codage doit être tel que défini par le polynôme de génération CRC Ethernet standard (voir ISO/CEI 8802-3).

Le CRC MDT doit être généré par le maître et transmis dans chaque MDT (MDT0 à MDT3). Ce CRC doit être évalué dans chaque MDT par l'esclave (voir Tableau 6).

4.5.6 Charge utile MDT pendant l'initialisation

4.5.6.1 Généralités

Le contenu du champ de données MDT dépend de la phase de communication (CP) et est décrit dans les paragraphes suivants.

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4.5.6.2 CP0

Le maître doit toujours transmettre uniquement des télégrammes MDT0, mais aucun télégramme MDT1, MDT2 ou MDT3. Le MDT0 doit être structuré tel qu'indiqué dans le Tableau 8.

Tableau 8 – Structure MDT0 dans la phase CP0

Elément DLPDU	Champ de données	Type de données	Valeur/description
MDT	Type de MDT	octet[1]	MDT0, voir 4.5.3
	Phase de MDT	octet[1]	(CP0, voir 4.5.4
	CRC MDT	octet[4]	voir 4.5.5
Charge utile MDT	Version de communication	octet[4]	voir Tableau 9
	Champ de données MDT	octet[36]	Doit être rempli et non utilisé

Tableau 9 – Version de communication

Numéro de bit	Valeur de bit	Description
31-23	—	(réservé: 0x00 comme combinaison valide doit être vérifiée par des esclaves)
22	—	SWC
	0	Appareils de Type non 19 (Ethernet industriel) non utilisés par l'application
	1	Appareils de Type non 19 (Ethernet Industriel) utilisés par l'application: le dernier esclave dans la ligne ne doit pas envoyer des télégrammes de Type 19 au port inactif (bouclage sans acheminement de télégrammes doit être activé), seul le dernier esclave doit être défini S-0-1032 Bit de commande de communication 3 = 1
21	—	Commutation CP rapide
	0	Transmission de MST (MDT0) interrompue lors de la commutation CP pendant le temps d'attente CPS (120 ms)
	1	Temps d'attente CPS réduit au temps de reconfiguration du maître (doit être acquitté par l'esclave dans le champ d'index de topologie de la phase CP0 de l'AT0)
20	—	Transmission des paramètres de communication dans MDT0 de la phase CP0
	0	Aucune transmission de paramètres
	1	Transmission des paramètres suivants: - Temps de début de transmission de l'AT0 (t1-CP1&CP2) - Début du canal UC (t6-CP1&CP2) - Fin du canal UC (t7-CP1&CP2)
19-18	—	(réservé: 0x00 comme combinaison valide doit être vérifiée par des esclaves)
17-16	—	Structure et nombre de MDT et AT dans les phases CP1 et CP2
	00	2 MDT et 2 AT dans les phases CP1 et CP2 (comprennent les SVC, C-DEV, S-DEV) – jusqu'à 255 esclaves
	01	4 MDT et 4 AT dans les phases CP1 et CP2 (comprennent les SVC, C-DEV, S-DEV) – jusqu'à 511 esclaves
	10	(réservé)
	11	(réservé)
15-8	—	(réservé)
7-1	—	(réservé: 0x00 comme combinaison valide doit être vérifiée par des esclaves)

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Numéro de bit	Valeur de bit	Description
0	—	Attribution d'adresse
	0	Sans attribution d'adresse (utilisé pour la Version 1.0 de type 19 uniquement)
	1	Attribution d'adresse (doit être utilisé pour la version 1.1.1 de type 19 et les versions supérieures)

4.5.6.3 CP1 et CP2

Le maître doit choisir entre deux séquences de communication utilisées dans les phases CP1 et CP2:

a) Lorsque le maître prend en charge un nombre d'esclaves inférieur ou égal à 255, il peut transmettre les MDT0 à MDT3 ou MDT0 et MDT1 uniquement, par exemple, pour économiser le temps d'initialisation.

b) Lorsque le maître prend en charge un nombre d'esclaves supérieur ou égal à 256 (jusqu'à 511 esclaves), il doit transmettre les MDT0 à MDT3.

Les esclaves doivent prendre en charge les deux options de séquence. Ils doivent sélectionner l'option requise en évaluant le bit 17 et le bit 16 de la version de communication (voir Tableau 9).

Les champs de données MDT doivent contenir la voie de service (voir 6.2) et la commande d'appareil (voir 4.5.7.4.2) des index de topologie comme cela est présenté dans le Tableau 10, le Tableau 11, le Tableau 12 et le Tableau 13 respectivement.

Dans la phase CP1, un esclave doit se comporter tel que demandé si le bit de protocole (MHS) est réglé sur 1 dans la commande SVC correspondante. Les INFO SVC MDT sont étiquetées "don’t care" (« sans importance »). Le contenu de la commande d'appareil doit être valide.

Les télégrammes de la phase CP2 doivent avoir la même structure que dans la phase CP1, mais le contenu de INFO SVC doit être valide uniquement dans la phase CP2.

Tableau 10 – MDT0 dans les phases CP1 et CP2 (index de topologie 0 à 127)

Elément DLPDU	Champ de données	Type de données	Valeur/description
MST MDT	Type de MDT	octet[1]	MDT0, voir 4.5.3
	Phase de MDT	octet[1]	CP1 ou CP2, voir 4.5.4
	CRC MDT	octet[4]	voir 4.5.5
Champ de données MDT	SVC MDT pour l'appareil esclave 0	octet[6]	—
	…	…	(Et ainsi de suite pour les index de topologie #1 à #126)
	SVC MDT pour l'index de topologie #127	octet[6]	—
	Commande d'appareil pour l'index de topologie #0	octet[2]	—
	Réservé pour l'index de topologie #0	octet[2]	—
	…	…	(Et ainsi de suite pour les index de topologie #1 à #126)
	Commande d'appareil pour l'index de topologie #127	octet[2]	—

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Elément DLPDU	Champ de données	Type de données	Valeur/description
	Réservé pour l'index de topologie #127	octet[2]	—

Tableau 11 – MDT1 dans les phases CP1 et CP2 (index de topologie 128 à 255)

Elément DLPDU	Champ de données	Type de données	Valeur/description
MST MDT	Type de MDT	octet[1]	MDT1, voir 4.5.3
	Phase de MDT	octet[1]	CP1 ou CP2, voir 4.5.4
	CRC MDT	octet[4]	voir 4.5.5
Champ de données MDT	SVC de l'index de topologie #128	octet[6]	—
	…	…	(Et ainsi de suite pour les index de topologie #129 à #254)
	SVC de l'index de topologie #255	octet[6]	—
	Commande d'appareil de l'index de topologie #128	octet[2]	—
	Réservé pour l'index de topologie #128	octet[2]	—
	…	…	(Et ainsi de suite pour les index de topologie #129 à #254)
	Commande d'appareil de l'index de topologie #255	octet[2]	—
	Réservé pour l'index de topologie #255	octet[2]	—

Tableau 12 – MDT2 dans les phases CP1 et CP2 (index de topologie 256 à 383)

Elément DLPDU	Champ de données	Type de données	Valeur/description
MST MDT	Type de MDT	octet[1]	MDT2, voir 4.5.3
	Phase de MDT	octet[1]	CP1 ou CP2, voir 4.5.4
	CRC MDT	octet[4]	voir 4.5.5
Champ de données MDT	SVC de l'index de topologie #256	octet[6]	—
	…	…	(Et ainsi de suite pour les index de topologie #257 à #382)
	SVC de l'index de topologie #383	octet[6]	—
	Commande d'appareil de l'index de topologie #256	octet[2]	—
	Réservé pour l'index de topologie #256	octet[2]	—
	…	…	(Et ainsi de suite pour les index de topologie #257 à #382)
	Commande d'appareil de l'index de topologie #383	octet[2]	—
	Réservé pour l'index de topologie #383	octet[2]	—

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Tableau 13 – MDT3 dans les phases CP1 et CP2 (index de topologie 384 à 511)

Elément DLPDU	Champ de données	Type de données	Valeur/description
MST MDT	Type de MDT	octet[1]	MDT3, voir 4.5.3
	Phase de MDT	octet[1]	CP1 ou CP2, voir 4.5.4
	CRC MDT	octet[4]	voir 4.5.5
Champ de données MDT	SVC de l'index de topologie #384	octet[6]	—
	…	…	(Et ainsi de suite pour les index de topologie #385 à #510)
	SVC de l'index de topologie #511	octet[6]	—
	Commande d'appareil de l'index de topologie #384	octet[2]	—
	Réservé pour l'index de topologie #384	octet[2]	—
	…	…	(Et ainsi de suite pour les index de topologie #385 à #510)
	Commande d'appareil de l'index de topologie #511	octet[2]	—
	Réservé pour l'index de topologie #511	octet[2]	—

4.5.6.4 CP3 et CP4

En phases CP3 et CP4, le maître doit transmettre des MDT de même structure (voir 4.5.7).

En phase CP3, seules la voie de service et la commande d'appareil doivent être valides. Les données d’application configurées dans les connexions des MDT ne doivent pas être évaluées, mais elles doivent avoir le nombre d'octets requis pour CP4. Les positions des voies de service et des connexions dans le MDT adaptées aux esclaves individuels, doivent correspondre aux positions de transmission par le maître aux esclaves au cours de la phase CP2, avec les paramètres de communication correspondants.

En phase CP4, les données d’application configurées doivent être valides et complétées par des valeurs de commande déterminées par les paramètres transmis par le maître aux esclaves au cours de la phase CP2. Les commandes de connexion et de ressource qui dépendent du profil d'application doivent être valides.

4.5.7 Charge utile MDT en fonctionnement normal

4.5.7.1 Introduction

La charge utile MDT de MDT0 (voir Tableau 14) doit toujours contenir

a) un champ de connexion à chaud MDT0 (voir 4.5.7.2) et selon la configuration;
b) un champ étendu MDT0,
c) plusieurs voies de service, mais une par esclave uniquement (voir 5.5.7.2.4);
d) plusieurs commandes d’appareil, mais une par esclave uniquement;
e) plusieurs connexions (voir 4.5.7.4).

La charge utile MDT de MDT1 à MDT3 (voir Tableau 14) peut contenir selon la configuration

a) plusieurs voies de service, mais une par esclave uniquement (voir 5.5.7.2.4);
b) plusieurs commandes d’appareil, mais une par esclave uniquement;

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c) plusieurs connexions (voir 4.5.7.4).

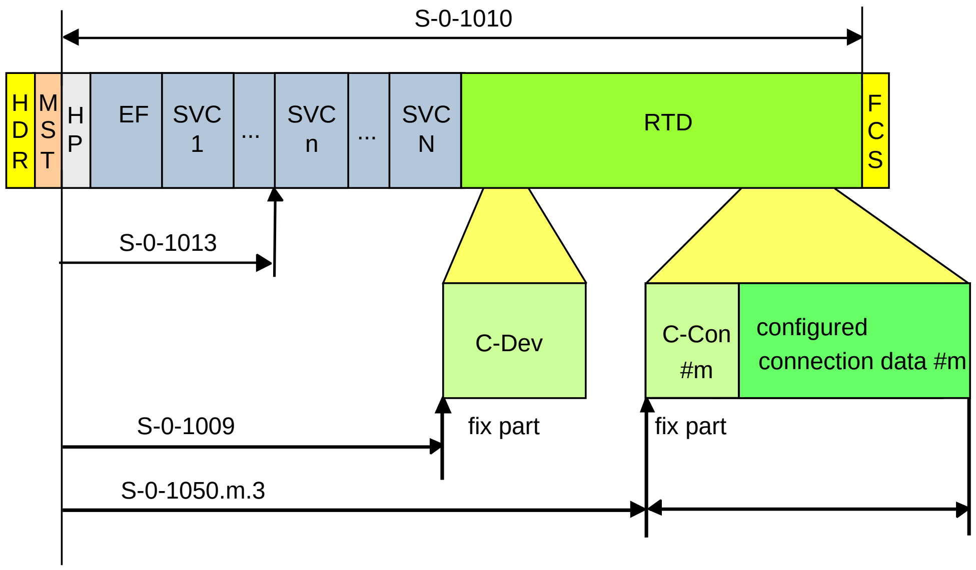
Tableau 14 – Champ de données MDT

Elément DLPDU	Champ de données	Type de données	Valeur/description
Champ de données MDT	Champ de connexion à chaud MDT0	octet[8]	Dans le champ MDT0 uniquement, voir 4.5.7.2
	Champ étendu MDT0	octet[4]	Dans le champ MDT0 uniquement, voir 4.5.7.2
	voies de service MDT	octet[voir 4.5.7.3]	Facultatif. voir 4.5.7.3
	Données en temps réel MDT	octet[voir 4.5.7.4]	Facultatif. voir 4.5.7.4

Pour chaque esclave,

- IDN S-0-1013 (décalage de SVC en MDT) doit définir le décalage applicable à sa voie de service;
- IDN S-0-1009 (Décalage de commande d'appareil en MDT) doit définir le décalage pour la commande d'appareil;
- IDN S-0-1050.x.3 (attribution de télégrammes) doit définir le décalage pour les données de connexion;
- IDN S-0-1050.x.5 (longueur actuelle de connexion) doit contenir la longueur des données de connexion;
- IDN S-0-1010 (longueurs des MDT) doit contenir les longueurs de tous les MDT (dans la Figure 1 présentée pour le champ MDT0 uniquement).

Ces paramètres doivent être transmis par le maître aux esclaves en phase CP2.



Légende

Anglais	Français
C-Dev	Commande d'appareil
C-Con	Commande de connexion
Configured connection data	Données de connexion configurées
Fix part	Partie fixe

Figure 1 – Exemple de décalages dans la charge utile MDT

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4.5.7.2 Champ de connexion à chaud MDT

4.5.7.2.1 Synthèse de champs de connexion à chaud MDT

La structure du champ de connexion à chaud MDT doit être comme cela est spécifié dans le Tableau 15 selon les phases de même nature (voir 5.5).

Tableau 15 – Champ de connexion à chaud MDT

Elément DLPDU	Champ de données	Type de données	Valeur/description
Champ de connexion à chaud MDT	Adresse HP MDT	octet[2]	voir 4.5.7.2.2
	commande HP	octet[2]	voir 4.5.7.2.3
	INFO HP MDT	octet[4]	voir 4.5.7.2.4

4.5.7.2.2 Champ d'adresse HP MDT

Le contenu du champ d'adresse HP dans le MDT doit être comme cela est spécifié dans le Tableau 16:

Tableau 16 – Adresse HP dans le champ HP MDT

Numéro de bit	Valeur	Description
15-12	—	L'index d'esclave spécifie le nombre d'esclaves dans un appareil (un appareil peut contenir plusieurs esclaves)
	0-15	Index d'esclave (défini par le maître en HP0)
11-0	—	Adresses d'appareil
	0-511	Adresses d'appareil pour exploitation (définies par le maître en HP1 et HP2)
	512-4092	(réservé)
	4093	(réservé)
	4094	(réservé)
	4095	Adresse de diffusion (définie par le maître en HP0, et chaque esclave HP doit répondre à cette adresse)

4.5.7.2.3 Champ de commande HP (en HP0 et HP1)

Le contenu du champ de commande HP doit être comme cela est spécifié dans le Tableau 17.

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Tableau 17 – Champ de commande HP (en HP0 et HP1)

Numéro de bit	Valeur	Description
15	—	Prise en charge de la connexion à chaud (le maître doit régler ce bit sur 1 en phase CP4, si la connexion à chaud est prise en charge)
	0	Connexion à chaud non prise en charge par le maître (l'esclave doit commuter de HP0, HP1 ou HP2 sur le mode NRT)
	1	Connexion à chaud prise en charge par le maître (préparation de la fonction HP par l'esclave HP)
14-10	—	(réservé)
9	—	Activer / désactiver la connexion à chaud
	0	Connexion à chaud désactivée (l'esclave HP doit commuter sur HP0)
	1	Connexion à chaud activée (l'esclave HP doit évaluer le champ HP)
8	—	Champ HP par rapport à communication SVC
	0	Seul le champ HP est utilisé (le maître utilise uniquement le champ HP pour communiquer avec l'esclave HP)
	1	Le champ HP et SVC sont utilisés (le maître utilise le champ HP et la SVC pour communiquer avec l'esclave HP)
7-0	—	Codage des paramètres HP0 (0 à 127) Codage des paramètres HP1 (128 à 255)
	0	Aucun paramètre HP (les INFO HP MDT étiqueté «don't care")
	1	Durée du cycle de communication (tScyc, S-0-1002)
	2	Début du canal UC (t6, S-0-1017, élément de liste 0)
	3	Fin du canal UC (t76, S-0-1017, élément de liste 1)
	4	MTU demandée (S-0-1027.0.1)
	5	Version de communication (contenu de MDT0 de CP0)
	6-15	(réservé)
	16	Longueur de MDT0 (S-0-1010, élément de liste 0)
	17	Longueur de MDT1 (S-0-1010, élément de liste 1)
	18	Longueur de MDT2 (S-0-1010, élément de liste 2)
	19	Longueur de MDT3 (S-0-1010, élément de liste 3)
	20-31	(réservés pour la longueur de MDT (MDT4 à MDT15)
	32	Longueur de AT0 (S-0-1010, élément de liste 0)
	33	Longueur de AT1 (S-0-1010, élément de liste 1)
	34	Longueur de AT2 (S-0-1010, élément de liste 2)
	35	Longueur de AT3 (S-0-1010, élément de liste 3)
	36-47	(réservés pour la longueur de l'AT (AT4 à AT15)
	48-127	(réservé)
	—	Codage des paramètres HP1 (128 à 255)
	128	Décalage MDT-SVC (S-0-1013)
	129	Décalage AT-SVC (S-0-1014)
	130	Index de topologie (S-0-1042, si pris en charge)
	131-255	(réservé)

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4.5.7.2.4 Champs INFO HP MDT (en HP0 et HP1)

Le champ INFO HP MDT doit toujours avoir une longueur de 4 octets. Lorsque seules des données de connexion à chaud à 2 octets sont transmises, la valeur des données doit alors être celle du mot de niveau bas, la valeur du mot de niveau haut doit être "dont’care".

Le champ INFO HP MDT doit être le conteneur de l’échange des données de connexion à chaud entre le maître et l’appareil esclave HP, qui se déroule en étapes dans le champ HP MDT.

4.5.7.2.5 Champ étendu MDT

Le champ étendu (EF) peut être transmis dans le MDT0 derrière le champ de connexion à chaud (voir Tableau 18). Le champ étendu prend en charge la transmission des fragments de temps et le TSref-counter.

1) Fragments de temps: Le maître transmet sa propre durée (8 octets) aux esclaves en 4 fragments avec 2 octets, par l’intermédiaire de ce champ. La fragmentation est contrôlée par 2 bits et le cycle CNT de MST.
   - Le bit valide "Fragment de temps" est réglé sur 1 par le maître si les données du champ "Fragments de temps" sont valides et le cycle CNT de MST est égal à 0. Le maître peut régler ce bit sur 0 à tout moment.
   - Activer la durée: Dans un transfert continu de fragments de temps, ce bit est basculé lorsque le maître a transmis une nouvelle durée et le cycle CNT de MST est égal à 0.
2) TSref-counter: Ce compteur a une longueur de 14 bits et compte modulo à l’aide de la valeur du paramètre S-0-1061.
   - La valeur initiale de TSref-counter est 0.
   - Le maître incrémente le TSref-counter de 1 dans chaque cycle de communication.
   - Le maître calcule le plus petit commun multiple (LCM) de toutes les durées de cycle du producteur et inscrit la valeur LCM dans S-0-1061. Si le TSref-counter atteint la valeur LCM calculée, le maître règle alors ce dernier sur 0, et la fonction redémarre (fonction modulo).

Si les SCP_Classes SCP_SYNC 0x02 ou SCP_SysTime sont activées par le maître, le champ étendu est présent dans le MDT0 des phases CP3 et CP4.

Tableau 18 – Champ étendu (EF)

Numéro de bit	Valeur	Description
31	—	Activer la durée
	commutation	Le maître a transmis une nouvelle durée de manière continue. L’esclave doit régler la nouvelle durée dans son système temporel interne.
30	—	Fragment de temps valide
	0	Non valide (fragment de temps non valide. L’esclave ne doit pas utiliser ce fragment de temps)
	1	Valide (fragment de temps valide. L’esclave doit utiliser ce fragment de temps)
29-16		TSref-counter (compteur modulo avec le plus petit commun multiple de durées de cycle de producteur différentes qui doivent être synchronisées)
15-0		Fragment de temps (fragments de temps actuel de Type 19, multiplexés avec le Cycle CNT de MST)

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4.5.7.3 Champ de voie de service (SVC) MDT

4.5.7.3.1 Synthèse des champs de voie de service MDT

Le champ de voie de service MDT (voir Tableau 19) doit contenir toutes les voies de service (SVC) des appareils configurés dans un réseau de Type 19. Seuls les appareils esclaves configurés doivent avoir leur propre voie de service dédiée, selon l'application, tandis que l'ordre des adresses d'appareil ne doit faire l'objet d'aucune restriction.

La voie de service de chaque appareil doit être comme cela est spécifié dans le Tableau 20.

Tableau 19 – Champ de voie de service MDT

Elément DLPDU	Champ de données	Type de données	Valeur/description
champ de voie de service MDT	SVC MDT pour l'appareil esclave 1	octet[6]	—
	SVC MDT pour l'appareil esclave 2	octet[6]	—
	…	…	(Et ainsi de suite pour l'appareil esclave 3 jusqu'à l'appareil esclave (N-1))
	SVC MDT pour l'appareil esclave N	octet[6]	—

Tableau 20 – SVC MDT (pour chaque esclave)

Elément DLPDU	Champ de données	Type de données	Valeur/description
SVC MDT de l'appareil esclave #k	commande SVC	octet[2]	Décalage dans le MDT défini par le décalage dans le MDT de l'esclave attribué (S-0-1013 SVC)
	INFO SVC MDT	octet[4]	—

4.5.7.3.2 Commande SVC

Le contenu du mot de commande de voie de service (SVC) doit être comme cela est spécifié dans le Tableau 21.

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Tableau 21 – Mot de commande SVC (DLL)

Numéro de bit	Valeur de bit	Description du mot de commande
15-6	—	(réservé)
5-3	—	Elément de bloc de données
	000	Voie de service non active, ferme la voie de service ou interrompt la transmission en cours
	001	IDN des données d'exploitation. La voie de service est fermée pour l'ancien IDN et ouverte pour le nouvel IDN
	010	Nom des données d'exploitation
	011	Attribut des données d'exploitation
	100	Unité des données d'exploitation
	101	Valeur d'entrée minimale
	110	Vitesse d'entrée maximale
	111	Données d'exploitation
2	—	Dernière transmission de bits
	0	Transmission en cours
	1	Dernière transmission
1	—	R/W (lecture/écriture)
	0	Lecture INFO SVC
	1	Ecriture INFO SVC
0	—	MHS (bit de protocole du maître)
	basculement	Protocole de transport du maître

4.5.7.3.3 INFO SVC MDT

Le champ INFO SVC MDT doit toujours avoir une longueur de 4 octets. Lorsque seuls 2 octets sont transmis en une étape, les données doivent alors être celles du mot de niveau bas, et la valeur du mot de niveau haut doit être "don't care".

Le champ INFO SVC MDT doit être le conteneur de l'échange des données non cycliques entre le maître et l'appareil esclave, qui se déroule en étapes dans le champ SVC MDT.

4.5.7.4 Champ de données en temps réel MDT

4.5.7.4.1 Généralités

Chaque esclave doit avoir une seule commande d'appareil comme cela est spécifié dans le Tableau 22.

Chaque esclave peut avoir plusieurs connexions comme cela est spécifié dans le Tableau 23.

Les données de connexion de tout appareil d'esclave ne doivent pas être réparties en deux MDT différents. Aucune restriction ne doit s'appliquer aux paramètres de décalage (S-0-1009, S-0-1050.x.03) eu égard à l'ordre des adresses d'appareil.

Le maître doit traiter au moins la commande d'appareil et les données d'application pendant la durée de cycle de production correspondante. Lorsqu'un maître comporte plusieurs connexions avec des durées de cycle de production différentes à un seul esclave, la commande d'appareil doit alors être actualisée par le maître à l'aide du cycle de production le plus rapide.

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Tableau 22 – Commande d'appareil MDT

Elément DLPDU	Champ de données	Type de données	Valeur/description
Données en temps réel #k	Commande d'appareil	octet[2]	Décalage du MDT défini par la commande d’appareil (C-DEV) ou S-0-1009 Décalage du MDT de l’esclave attribué

La commande d'appareil doit être présente pour chaque esclave à une occurrence exactement.

Tableau 23 – Données d’application MDT

Elément DLPDU	Champ de données	Type de données	Valeur/description
Données en temps réel de l'appareil esclave #k	Données d’application	Conteneur	Décalage du MDT défini par Attribution de télégrammes de l’esclave attribué ou S-0-1050.x.03

NOTE Les données d’application peuvent être présentes pour chaque esclave 0.-255 fois.

La fonctionnalité d'une connexion est décrite en 4.7.

4.5.7.4.2 Commande d'appareil

Le contenu du champ de commande d'appareil doit être comme cela est spécifié dans le Tableau 24.

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Tableau 24 – Champ de commande d'appareil (C-DEV)

Numéro de bit	Valeur de bit	Description
15	—	Identification
	0	Pas de demande d'identification
	1	Demande d'identification (l'esclave présente l'état de ce bit à la DEL de Type 19 ou à l'affichage). Cette fonction sert à l'attribution d'adresse distante ou est utilisée pour les erreurs de configuration entre le maître et l'esclave.
14	—	Topologie HS (la valeur initiale est de 0 dans chaque CP)
	basculement	Le maître bascule à chaque fois qu'il requiert une modification de topologie.
13-12	—	Contrôle de topologie (le maître choisit la nouvelle topologie)
	00	Acheminement rapide sur les deux ports
	01	Bouclage avec acheminement de télégrammes P
	10	Bouclage avec acheminement de télégrammes S
	11	(réservé: l'esclave doit ignorer cette combinaison de bits)
11	—	Contrôle de topologie physique (si l'esclave détecte une commutation, il doit alors ignorer la table d'adresses source. Le contrôle de topologie physique est utilisé uniquement dans le canal UC)
	0	rupture de l'anneau physique
	1	fermeture de l'anneau physique
10-9	—	(réservé)
8	—	Maître valide (indique si le maître traite des données. En phase CP1, l'esclave détecte la prise en charge de cette fonction, si ce bit est réglé sur 1 par le maître)
	0	Maître non valide (le maître doit régler ce bit sur 0, si le maître active l'état NRT ou CP0. Le contenu de la commande d'appareil C-DEV n'est pas valide. Le bit "Producteur prêt" de toutes les connexions de production doit être réglé sur 0)
	1	Maître valide (Lorsque cela est pris en charge, le maître doit régler ce bit sur 1, si le maître active CP1. Le contenu de la commande d'appareil C-DEV est valide)
7-0	—	(réservé)

4.6 DLPDU AT

4.6.1 Synthèse de champ d'en-tête d'AT

L'AT est un télégramme de Type 19 et doit être comme cela est spécifié dans le Tableau 25. L'en-tête de Type 19 est appelé "en-tête d'AT".

Tableau 25 – En-tête de MST AT

Elément DLPDU	Champ de données	Type de données	Valeur/description
En-tête d'AT	Type d'AT	octet[1]	voir 4.6.3
	Phase d'AT	octet[1]	voir 4.6.4
	CRC AT	octet[4]	voir 4.6.5

4.6.2 Evaluation de l'en-tête d'AT dans les esclaves

L'en-tête d'AT doit être généré par le maître et évalué par les esclaves. Chaque esclave doit évaluer l'en-tête d'AT selon le Tableau 26.

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Tableau 26 – Champs d'en-tête de l'AT à prendre en compte par l'esclave

	Type d'AT	Phase d'AT	CRC AT
AT0	Oui	Non	Oui
AT1	Oui	Non	Oui
AT2	Oui	Non	Oui
AT3	Oui	Non	Oui

NOTE L'esclave n'a à évaluer le type d'AT que si le CRC AT est valide.

4.6.3 Type d'AT

Se reporter à 4.4.2, où le bit #6 doit être égal à 1.

4.6.4 Phase d'AT

La phase d'AT doit contenir l'état de la communication de Type 19 pendant l'initialisation et au cours de la phase CP4. La phase doit être générée par le maître et transmise dans chaque AT. La structure est identique à celle de la phase MDT (voir 4.5.4).

La phase d'un AT ne doit pas être évaluée par l'esclave (voir Tableau 26).

4.6.5 CRC AT

Les CRCT AT doivent être générés par le maître comme CRC MDT (voir 4.5.5).

Les CRC AT doivent être évalués par l'esclave (voir Tableau 26).

4.6.6 Charge utile AT pendant l'initialisation

4.6.6.1 Généralités

Le contenu de la charge utile AT dépend de la phase de communication (CP) comme décrit dans les paragraphes suivants.

4.6.6.2 Charge utile d'AT en phase CP0

Le maître doit toujours transmettre des télégrammes AT0, mais aucun télégramme AT1, AT2 ou AT3. L'AT0 doit être structuré tel qu'indiqué dans le Tableau 27. Le Tableau 27 spécifie également les données de charge utile AT0 que le maître doit remplir de valeurs initiales. Le maître doit

- régler le compteur de séquences sur 0x0001 et / ou sur 0x8001 (selon la topologie associée);
- remplir tous les champs d'index de topologie avec 0xFFFF.

Les ports Px et Py dans le Tableau 27 sont interchangeables, ce qui signifie que les ports Px et Py peuvent être le port P1 ou le port P2.

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Tableau 27 – Structure AT0 dans la phase CP0

Elément DLPDU	Champ de données	Type de données	Valeur/description
MST AT	Type d'AT	octet[1]	AT0, voir 4.6.3
	Phase d'AT	octet[1]	CP0, voir 4.6.4
	CRC AT	octet[4]	voir 4.6.5
Charge utile AT	Compteur de séquences	octet[2]	Valeurs initiales : 0x0001 (Port Px), 0x8001 (Port Py) Valeur reçue (Port Px): 0x08001+ nombre d'esclaves (avec anneau) 0x0001+(2*nombre d'esclaves)-1 (avec ligne) Valeur reçue (Port Py): 0x0001+ nombre d'esclaves (avec anneau) 0x8001+(2* nombre d'esclaves)-1 (avec ligne)
	Index de topologie #1	octet[2]	Valeur initiale 0xFFFF (pour les ports Px et Py) Valeur reçue (ports Px et Py) : adresse d'appareil si l'esclave est présent.
	Index de topologie #2 à #510	octet[2*509]	Valeur initiale 0xFFFF (pour les ports Px et Py) Valeur reçue (ports Px et Py) : adresse d'appareil si l'esclave est présent.
	Index de topologie #511	octet[2]	Valeur initiale 0xFFFF (pour les ports Px et Py) Valeur reçue (ports Px et Py) : adresse d'appareil si l'esclave est présent.

Le contenu du champ d'index de topologie dans l'AT0 de la phase CP0 doit être comme cela est spécifié dans le Tableau 28.

Tableau 28 – Adresse de topologie dans le champ AT0-CP0

Numéro de bit	Valeur	Description
Maître (15-0)	0xFFFF	réglé par le maître
Esclave (15)	—	Prise en charge des fonctions requises dans la version de communication de MDT0-CP0 (voir 5.2.4, Tableau 9)
	0	L'esclave ne prend pas en charge une ou plusieurs fonctions requises (les valeurs par défaut sont activées)
	1	L'esclave prend en charge toutes les fonctions requises (les valeurs par défaut sont activées)
Esclave (14-9)	—	(réservé)
Esclave (8-0)	—	Adresses d'appareil
	0-511	Adresses d'appareil valides

4.6.6.3 Charge utile d'AT en phases CP1 et CP2

Le maître doit choisir entre deux séquences de communication dans les phases CP1 et CP2:

a) Lorsque le maître prend en charge un nombre d'esclaves inférieur ou égal à 255, il peut transmettre les télégrammes AT0 à AT3 ou AT0 et AT1 uniquement, par exemple, pour économiser le temps d'initialisation. Les esclaves doivent prendre en charge les deux options de séquence par l'évaluation de la version de communication (voir Tableau 9).

b) Lorsque le maître prend en charge un nombre d'esclaves supérieur ou égal à 256 (jusqu'à 511 esclaves), il doit transmettre les télégrammes AT0 à AT3.

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Le champ de données AT de l'AT0 doit contenir la voie de service (voir 4.6.7.3) et l'état d'appareil (voir 4.6.7.4.2) des index de topologie comme cela est présenté dans le Tableau 29, le Tableau 30, le Tableau 31 et le Tableau 32 respectivement.

En phase CP1, l'esclave sollicité doit répondre en réglant le bit de protocole (AHS) et le bit valide (SVC valide) sur 1 dans l'état SVC correspondant. Les INFO SVC AT sont étiquetées "don't care".

A l'état d'appareil, l'esclave doit traiter les bits suivants:

a) bit valide de l'esclave réglé sur 1;

b) bits de topologie actualisés;

c) niveau de paramétrage et interface d'erreur de communication valides.

En phase CP2, les télégrammes doivent avoir la même structure que dans la phase CP1, mais le contenu de INFO SVC AT doit être valide dans la phase CP2.

Tableau 29 – AT0 dans les phases CP1 et CP2 (index de topologie 0 à 127)

Elément DLPDU	Champ de données	Type de données	Valeur/description
En-tête d'AT	Type d'AT	octet[1]	AT0, voir 4.6.3
	Phase d'AT	octet[1]	CP1 ou CP2, voir 4.6.4
	CRC AT	octet[4]	voir 4.6.5
Champ de données AT	SVC AT pour l'index de topologie #0	octet[6]	—
	…	octet[6*126]	(et ainsi de suite pour les index de topologie #1 à #126)
	SVC AT pour l'index de topologie #127	octet[6]	—
	Etat d'appareil pour l'index de topologie #0	octet[2]	—
	Réservé pour l'index de topologie #0	octet[2]	—
	…	octet[2*126]	(Et ainsi de suite pour les index de topologie #1 à #126)
	Etat d'appareil pour l'index de topologie #127	octet[2]	—
	Réservé pour l'index de topologie #127	octet[2]	—

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Tableau 30 – AT1 dans les phases CP1 et CP2 (index de topologie 128 à 255)

Elément DLPDU	Champ de données	Type de données	Valeur/description
En-tête d'AT	Type d'AT	octet[1]	AT1, voir 4.6.3
	Phase d'AT	octet[1]	CP1 ou CP2, 4.6.4
	CRC AT	octet[4]	voir 4.6.5
Champ de données AT	SVC AT pour l'index de topologie #128	octet[6]	—
	…	octet[6*126]	(Et ainsi de suite pour les index de topologie #129 à #254)
	SVC AT pour l'index de topologie #255	octet[6]	—
	Etat d'appareil pour l'index de topologie #128	octet[2]	—
	Réservé pour l'index de topologie #128	octet[2]	—
	…	octet[2*126]	(Et ainsi de suite pour les index de topologie #129 à #254)
	Etat d'appareil pour l'index de topologie #255	octet[2]	—
	Réservé pour l'index de topologie #255	octet[2]	—

Tableau 31 – AT2 dans les phases CP1 et CP2 (index de topologie 256 à 383)

Elément DLPDU	Champ de données	Type de données	Valeur/description
En-tête d'AT	Type d'AT	octet[1]	AT3, voir 4.6.3
	Phase d'AT	octet[1]	CP1 ou CP2, 4.6.4
	CRC AT	octet[4]	voir 4.6.5
Champ de données AT	SVC AT pour l'index de topologie #256	octet[6]	—
	…	octet[6*126]	(Et ainsi de suite pour les index de topologie #257 à #382)
	SVC AT pour l'index de topologie #383	octet[6]	—
	Etat d'appareil pour l'index de topologie #256	octet[2]	—
	Réservé pour l'index de topologie #256	octet[2]	—
	…	octet[2*126]	(Et ainsi de suite pour les index de topologie #257 à #382)
	Etat d'appareil pour l'index de topologie #383	octet[2]	—
	Réservé pour l'index de topologie #383	octet[2]	—

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Tableau 32 – AT3 dans les phases CP1 et CP2 (index de topologie 384 à 511)

Elément DLPDU	Champ de données	Type de données	Valeur/description
En-tête d'AT	Type d'AT	octet[1]	AT3, voir 4.6.3
	Phase d'AT	octet[1]	CP1 ou CP2, 4.6.4
	CRC AT	octet[4]	voir 4.6.5
Champ de données AT	SVC AT pour l'index de topologie #384	octet[6]	—
	…	octet[6*126]	(Et ainsi de suite pour les index de topologie #385 à #510)
	SVC AT pour l'index de topologie #511	octet[6]	—
	Etat d'appareil pour l'index de topologie #0	octet[2]	—
	Réservé pour l'index de topologie #0	octet[2]	—
	…	octet[2*126]	(Et ainsi de suite pour les index de topologie #385 à #510)
	Etat d'appareil pour l'index de topologie #511	octet[2]	—
	Réservé pour l'index de topologie #511	octet[2]	—

4.6.6.4 Charge utile d'AT en phase CP3

En phase CP3, le maître doit transmettre des AT de la même structure qu'en phase CP4. Les esclaves intègrent leurs données dans les champs de données correspondants.

En phase CP3, seuls la voie de service et l'état d'appareil doivent être valides. Les données d'application configurables dans les connexions des AT ne doivent pas être évaluées, mais elles doivent avoir le nombre d'octets requis pour la phase CP4. Les positions des voies de service et des connexions dans l'AT adaptées aux esclaves individuels, doivent correspondre aux positions de transmission par le maître aux esclaves au cours de la phase CP2, avec les paramètres de communication correspondants.

4.6.7 Charge utile d'AT en phase CP4

4.6.7.1 Introduction

En phase CP4, le maître doit transmettre des AT de la même structure qu'en phase CP3. Les esclaves intègrent leurs données dans les champs de données correspondants.

En phase CP4, les données en temps réel configurables doivent être valides et complétées par des valeurs réelles déterminées par les paramètres transmis par le maître aux esclaves au cours de la phase CP2. La commande de connexion et l'état de ressource qui dépendent du profil d'application doivent être valides.

La charge utile AT de l'AT0 (voir Tableau 33) doit toujours contenir

- un champ de connexion à chaud AT0 selon la configuration;
- plusieurs voies de service, mais une par esclave uniquement;
- plusieurs états d'appareil, mais un par esclave uniquement;
- plusieurs connexions.

La charge utile AT de AT1 à AT3 (voir Tableau 33) peut contenir selon la configuration

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- plusieurs voies de service, mais une par esclave uniquement;
- plusieurs états d'appareil, mais un par esclave uniquement;
- plusieurs connexions.

La structure de charge utile AT doit être comme cela est spécifié dans le Tableau 33.

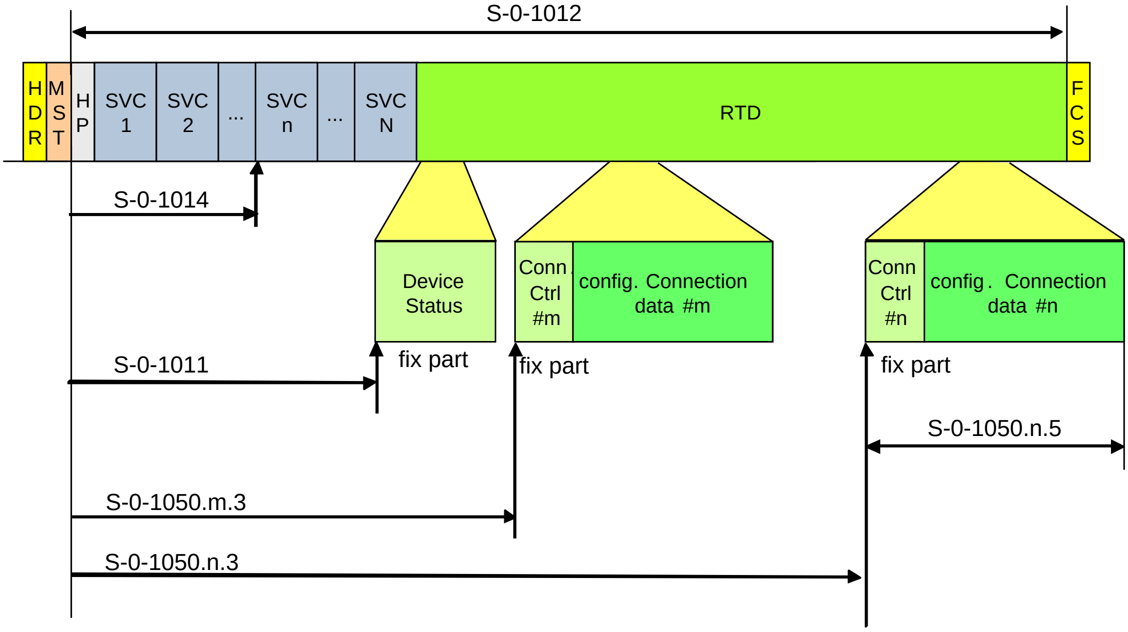
Tableau 33 – Champ de données AT

Elément DLPDU	Champ de données	Type de données	Valeur/description
Champ de données AT	Champ de connexion à chaud AT0	octet[8]	En AT0 uniquement, voir 4.6.7.2
	voies de service AT	octet[voir 4.6.7.3]	Facultatif, voir 4.6.7.3
	Données en temps réel AT	octet[voir 4.6.7.4]	Facultatif. voir 4.6.7.4

Pour chaque esclave,

- L'IDN S-0-1014 (décalage SVC dans AT) doit définir le décalage pour sa voie de service;
- L'IDN S-0-1011 (état d'appareil S-DEV) doit définir le décalage pour l'état d'appareil;
- L'IDN S-0-1050.x.3 (attribution de télégrammes) doit définir le décalage pour les données de connexion;
- L'IDN S-0-1050.x.5 (Longueur actuelle de connexion) doit contenir la longueur des données de connexion;
- L'IDN S-0-1012 (longueur des AT) doit définir la longueur des AT (voir Figure 2).

Ces paramètres doivent être transmis par le maître aux esclaves en phase CP2.



Légende

Anglais	Français
Device status	Etat d'appareil
Conn Ctrl	Commande de connexion
Config. connection data	Données de connexion configurées

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Anglais	Français
Fix part	Partie fixe

Figure 2 – Exemple de décalages dans la charge utile AT

4.6.7.2 Champ de connexion à chaud AT

4.6.7.2.1 Synthèse de champs de connexion à chaud AT

La structure du champ de connexion à chaud AT doit être comme cela est spécifié dans le Tableau 34 selon les phases de même nature (voir 5.5).

Tableau 34 – Champ de connexion à chaud AT en HP0 et HP1

Elément DLPDU	Champ de données	Type de données	Valeur/description
Champ de connexion à chaud AT	Adresse HP AT	octet[2]	voir 4.6.7.2.2
	Etat HP	octet[2]	S-HP, voir 4.6.7.2.3
	INFO HP AT	octet[4]	(réservé, voir 5.5)

4.6.7.2.2 Champ d'adresse HP AT

Le contenu du champ d'adresse HP dans l'AT doit être comme cela est spécifié dans le Tableau 35.

Tableau 35 – Adresse HP dans le champ HP AT

Numéro de bit	Valeur	Description
15-12	—	L'index d'esclave spécifie le nombre d'esclaves dans un appareil (l'appareil peut contenir plusieurs esclaves)
	0..15	Index d'esclave (défini par l'esclave en HP1)
11-0	—	Adresses d'appareil
	0-511	Adresses d'appareil pour exploitation (défini par l'esclave en HP1 et HP2)
	512-4092	(réservé)
	4093	Fin d'analyse des index d'esclave (un indice non utilisé a été détecté par l'esclave HP), définie par l'esclave en HP1
	4094	(réservé)
	4095	(réservé)

4.6.7.2.3 Champ d'état HP (en HP0 et HP1)

Le contenu du champ d'état HP doit être comme cela est spécifié dans le Tableau 36.

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Tableau 36 – Champ d'état HP (en HP0 et HP1)

Numéro de bit	Valeur	Description
15-9	—	(réservé)
8	—	Etat HP
	0	Acquittement en HP1 (code, voir bit 7-0)
	1	Erreur en HP1 (code d'erreur, voir bit 7-0)
7-0	—	Codes d'acquittement ou d'erreur HP1
	0	(réservé)
	1	Acquittement: Aucune donnée dans INFO HP AT (bit 8=0, INFO HP AT est étiquetée "dont' care")
	2	Erreur: activation de SVC (bit 8 =1, erreur survient lors de l'activation de SVC dans l'esclave HP)
	3	(réservé)
	4	Erreur: Adresse d'appareil (bit 8 =1, le maître ne transmet pas l'adresse sercos de l'esclave HP)
	5	Erreur : Analyse de l'esclave (bit 8 =1, le maître n'a pas analysé tous les esclaves dans un appareil à plusieurs esclaves)
	6 à 127	(réservé)
	128	Pointeur SVC MDT (doit être pris en charge bit 8 = 0 --> aucune erreur, paramètre valide bit 8 = 1 --> erreur, paramètre non valide)
	129	Pointeur SVC AT (doit être pris en charge bit 8 = 0 --> aucune erreur, paramètre valide bit 8 = 1 --> erreur, paramètre non valide)
	130	Index de topologie
	131 à 254	(réservé)
	255	Erreur l'esclave HP reçoit sa propre adresse d'appareil sur son port inactif (bit 8 = 1 --> l'esclave HP suivant connecté à cet esclave HP a la même adresse d'appareil)

4.6.7.3 Champ de voie de service AT

4.6.7.3.1 Synthèse des champs de voie de service AT

Le champ de voie de service AT (voir Tableau 37) doit contenir toutes les voies de service (SVC) des appareils configurés dans un réseau de Type 19.

Chaque esclave configuré doit avoir sa propre voie de service dédiée, selon l'application, tandis que l'ordre des adresses d'appareil ne doit faire l'objet d'aucune restriction.

La voie de service de chaque esclave doit être comme cela est spécifié dans le Tableau 38.

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Tableau 37 – Champ de voie de service AT

Elément DLPDU	Champ de données	Type de données	Valeur/description
champ de voie de service AT	SVC AT pour l'esclave # 1	octet[6]	voir Tableau 38
	SVC AT pour l'esclave # 2	octet[6]	voir Tableau 38
	…	…	(Et ainsi de suite pour les esclaves #3 jusqu'aux esclaves #(N-1))
	SVC AT pour l'esclave #N	octet[6]	voir Tableau 38

Tableau 38 – SVC AT (pour chaque esclave)

Elément DLPDU	Champ de données	Type de données	Valeur/description
SVC AT de l'appareil esclave #k	état SVC	octet[2]	Décalage de l'AT défini par S-0-1014 (décalage SVC dans AT) de l'esclave attribué.
	INFO SVC AT	octet[4]	—

4.6.7.3.2 Etat SVC AT

La structure de l'état SVC doit être comme cela est spécifié dans le Tableau 39.

Tableau 39 – Description d'état SVC AT (DLL)

Numéro de bit	Valeur de bit	Description
15-4	—	(réservé)
3	—	Traitement SVC
	0	SVC non valide (l'esclave ne traite pas la SVC AT dans ce canal P ou S)
	1	SVC valide (l'esclave traite la SVC AT dans ce canal P ou S)
2	—	Erreur SVC
	0	Pas d'erreur
	1	Erreur dans la voie de service (SVC) (message d'erreur dans INFO SVC)
1	—	Occupé
	0	Etape terminée (esclave prêt pour une nouvelle étape)
	1	Etape en cours (nouvelle étape interdite)
0	—	AHS
	basculement	protocole de transport SVC de l'esclave (bit de basculement)

4.6.7.3.3 INFO SVC AT

Le champ INFO SVC AT doit toujours avoir une longueur de 4 octets. Lorsque seuls 2 octets sont transmis en une étape, les données doivent alors être celles du mot de niveau bas, et la valeur du mot de niveau haut doit être "don't care".

Le champ INFO SVC AT doit être le conteneur dédié à l'échange de données non cycliques entre tout esclave et le maître, qui se déroule en plusieurs étapes dans le champ SVC AT du télégramme.

4.6.7.4 Champ de données en temps réel AT

4.6.7.4.1 Généralités

Chaque esclave doit avoir un seul état d'appareil (voir Tableau 40).

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Chaque esclave peut avoir plusieurs connexions comme cela est spécifié dans le Tableau 41.

Les données de connexion de tout appareil d'esclave ne doivent pas être réparties en deux AT différents. Aucune restriction ne doit s'appliquer aux paramètres de décalage (S-0-1009, S-0-1050.x.03) eu égard à l'ordre des adresses d'appareil.

L'esclave doit traiter au moins l'état d'appareil et les données d'application pendant la durée de cycle de production correspondante. Lorsqu'un esclave comporte plusieurs connexions avec des durées de cycle de production différentes au maître ou à d'autres esclaves, l'état d'appareil doit alors être actualisé par l'esclave à l'aide du cycle de production le plus lent.

Tableau 40 – Etat d'appareil AT

Elément DLPDU	Champ de données	Type de données	Valeur/description
Données en temps réel #k	Etat de l'appareil	octet[2]	Décalage de l'AT défini par le décalage S-DEV de l'état d'appareil (ou S-0-1011) de l'AT de l'esclave attribué

L'état d'appareil doit être présent pour chaque esclave à une occurrence exactement.

Tableau 41 – Données de connexion AT

Elément DLPDU	Champ de données	Type de données	Valeur/description
Données en temps réel #k	Données d'application	Conteneur	Décalage de l'AT défini par le S-0-1050.x.03 (attribution de télégrammes) de l'esclave attribué

NOTE Les données d'application peuvent être présentes pour chaque esclave 0-255 fois.

La fonctionnalité d'une connexion est décrite en 4.7.

4.6.7.4.2 Etat d'appareil (S-DEV)

Le contenu du champ d'état d'appareil doit être comme cela est spécifié dans le Tableau 42.

Le temps de réaction le plus rapide à tout événement qui affecte l'état d'appareil, à l'exception des bits 11-10 (état de port inactif), doit se situer dans la durée de cycle de production la plus lente, et être au plus de 200 ms.

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Tableau 42 – Champ d'état d'appareil

Numéro de bit	Valeur de bit	Description
15	—	Interface d'avertissement de communication
	0	Pas d'avertissement
	1	Occurrence d'un avertissement de communication (par exemple, le nombre de pertes MST admises a dépassé la demi-valeur de S-0-1003)
14	—	Topologie HS
	basculement	La valeur initiale est de 0 dans chaque CP. L'esclave bascule, si la demande du maître a été reconnue, ce qui signifie que l'état de topologie peut être actualisé après le basculement.
13-10	—	Etat de topologie / état de port
	00-00	Acheminement rapide sur les deux ports (diagnostic non disponible)
	01-00	Bouclage avec acheminement de télégrammes P (aucune liaison sur le port inactif -->pas d'appareil connecté)
	01-01	Bouclage avec acheminement de télégrammes P (LIAISON (LINK) sur le port inactif -->appareil connecté)
	01-10	Bouclage avec acheminement de télégrammes P (LIAISON P: télégrammes P sur le port inactif -->appareil de Type 19 connecté)
	01-11	Bouclage avec acheminement de télégrammes P (LIAISON S: télégrammes S sur le port inactif -->appareil de Type 19 connecté)
	10-00	Bouclage avec acheminement de télégrammes S (pas de liaison sur le port inactif --> pas d'appareil connecté)
	10-01	Bouclage avec acheminement de télégrammes S (LIAISON sur le port inactif --> appareil connecté)
	10-10	Bouclage avec acheminement de télégrammes S (LIAISON P: télégrammes p sur le port inactif --> appareil de Type 19 connecté)
	10-11	Bouclage avec acheminement de télégrammes S (LIAISON S: télégrammes S sur le port inactif --> appareil de Type 19 connecté)
	11-xx	Archiver et acheminer ou transmission transparente
	00-xx	Combinaisons de bits supplémentaires:
	00-01	Acheminement rapide sur les deux ports (diagnostic pris en charge)
	00-10	Acheminement rapide sur les deux ports (erreur dans le canal P)
	00-11	Acheminement rapide sur les deux ports (erreur dans le canal S)
9	—	Connexion d'erreur
	0	Connexion sans erreur
	1	Erreur de connexion (le consommateur a reconnu une erreur de connexion)
8	—	Esclave valide (indique si un esclave traite les données)
	0	Esclave non valide (réglé sur 0 lors de l'entrée en phase CP0. Modifié pendant la phase CPS. Le contenu de l'état d'appareil S-DEV n'est pas valide. L'état "Producteur prêt" de toutes les connexions de production doit être réglé sur 0)
	1	Esclave valide (CP > CP0. Modifié pendant la phase CPS. Le contenu de l'état d'appareil (S-DEV) n'est pas valide)
7	—	Erreur (C1D), y compris les erreurs liées aux sous-appareils et aux ressources
	0	Pas d'erreur
	1	Erreur (les informations détaillées sont présentées en S-0-0390)
6	—	Avertissement (C2D), y compris les avertissements liés aux sous-appareils et aux ressources
	0	Pas d'avertissement
	1	Avertissement (les informations détaillées sont présentées en S-0-0390)
5	—	Bit de changement de commande de procédure

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Numéro de bit	Valeur de bit	Description
	0	Pas de changement dans l'acquittement de commande de procédure
	1	Changement de l'acquittement de commande de procédure (acquittement positif ou négatif de la commande de procédure)
4	—	Niveau de sous-appareil
	0	Niveau de fonctionnement (OL) actif
	1	Niveau de paramétrage (PL) actif
3	—	(réservé)
2	—	(réservé)
1-0	—	(réservé)

4.7 Mécanismes des connexions

4.7.1 Introduction

La communication connecte tous les participants d'un réseau. De ce fait, il est possible que chaque participant soit en mesure de communiquer avec tout autre participant. Une connexion détermine les participants communiquant effectivement entre eux. Le réseau de Type 19 prend en charge l'échange de données d'application entre le maître et tous les esclaves, et entre les esclaves dans les deux directions. Il n'est pas nécessaire que tous les participants communiquent entre eux, par conséquent, l'échange de données d'application entre les participants est configuré par l'intermédiaire de connexions. La fonctionnalité de connexion repose sur un modèle producteur-consommateur. Cela signifie que chaque transmission de données d'application requiert une connexion.

Une connexion doit avoir un seul producteur, mais elle peut en revanche ne comporter aucun ou plusieurs consommateurs. Dans la configuration de connexion (ou S-0-1050.x.01), le participant obtient les informations, que la connexion soit configurée en tant que producteur ou consommateur. La commande de connexion constitue une partie fixe de chaque connexion et est configurée de manière automatique. Les données d'application transmises de la connexion sont configurables.

Description et définitions de la Figure 5:

- saisir (write): L'application saisit les données d'application et le signale au producteur
- produire et définir (produce & set): D'abord le producteur introduit les données d'application dans la connexion, puis définit la commande de connexion (C-CON) relative au diagramme d'états du producteur
- évaluer & consommer (evaluate & consume): D'abord le consommateur évalue la C-CON, puis consomme les données d'application provenant de la connexion et le signale à l'application
- lire (read): L'application lit les données d'application provenant du consommateur.

Flux des données d'application d'une application à l'autre:

a) L'application (par exemple, unité de commande, lecteur, appareil E/S, etc.) génère les données d'application et les envoie sous forme écrite au producteur.
b) Le producteur est informé aussi et choisit l'état correspondant du diagramme d'états et produit les données d'application qu'il introduit dans la connexion et définit la commande de connexion sur la base des conditions de l'état du producteur.
c) La communication transmet toutes les connexions avec les données d'application contenues dans les télégrammes de Type 19.
d) Le consommateur évalue la commande de connexion et consomme les données d'application sur la base des conditions de l'état du consommateur.

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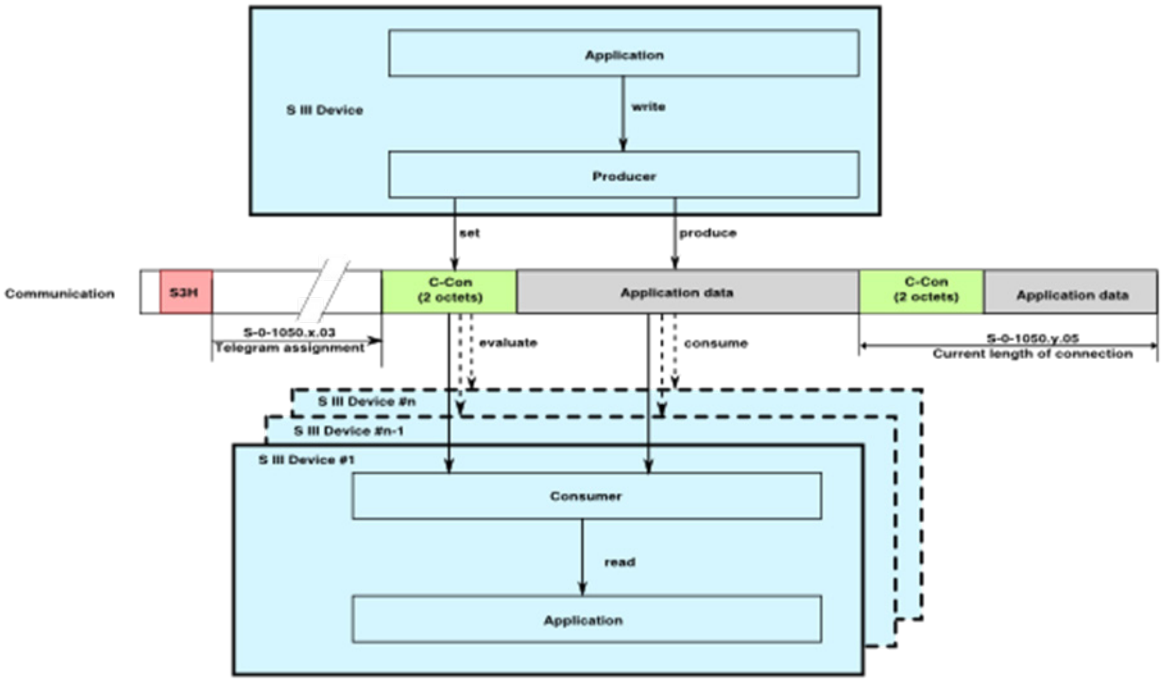
e) L'application est informée par le consommateur et lit les données d'application.



Légende

Anglais	Français
Application	Application
Write	saisir
S iii Device	appareil S III
Producer	producteur
Set	définir
produce	produire
Communication	communication
C-Con (2 octets)	commande de connexion (2 octets)
application data	données d'application
telegram assignment	attribution de télégrammes
evaluate	évaluer
consume	consommer
current length of connection	longueur actuelle de connexion
consumer	consommateur
read	lire

Figure 3 – Flux des données d'application

4.7.2 Configuration des connexions

La configuration des données d'application s'effectue en utilisant S-0-1050 (Connexions). Elle doit être attribuée à un esclave au cours de l'initialisation en phase CP2. Toutes les données d'application configurées dans une connexion doivent être protégées en écriture dans les phases CP3 et CP4.

Les règles de configuration des connexions sont les suivantes:

- Seules les données d'exploitation doivent être utilisées.

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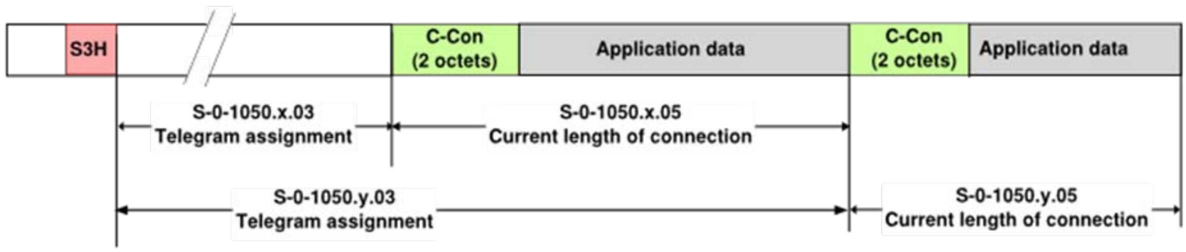
- La longueur des données déterminée de l'attribut est utilisée pour les données d'exploitation de longueur fixe.
- Pour les données d'exploitation de longueur variable, la longueur actuelle des données utilisée pour la connexion doit être arrondie à un nombre pair d'octets. Les indicateurs de longueur à 4 octets ne font pas partie intégrante des données d'application.
- Chaque donnée d'exploitation doit commencer avec un nombre pair d'octets dans la connexion.
- La structure de la connexion doit être déterminée par la liste de configuration étiquetée S-0-1050.x.6, voir Tableau 43.

La connexion doit être définie telle que configurée dans S-0-1050.x.01 (Configuration de connexion). Cette connexion connecte un producteur à tous les consommateurs. Selon la configuration, les données d'application doivent être:

- configurables par le maître pendant l'initialisation; voir S-0-1050.x.06 (Liste de configuration);
- configurables par l'esclave pendant l'initialisation, par exemple S-0-1500.x.05 (Données de sortie du conteneur) ou S-0-1500.x.09 (Données d'entrée du conteneur);
- comme cela est spécifié dans le paramètre de type de message S-0-0015 (type de message).

La position de la connexion dans un télégramme de Type 19 est définie par le S-0-1050.x.03 (Attribution de télégrammes) et le S-0-1050.x.05 (Longueur actuelle de connexion), voir Figure 4 .



Légende

Anglais	Français
C.Con (2 octets)	Commande de connexion (2 octets)
Connection data	Données de connexion
(e.g. application data)	(par exemple, données d'application)
Telegram assignment	Attribution de télégrammes
Current length of connection	Longueur actuelle de connexion

Figure 4 – Attribution de télégrammes et longueur de connexion

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Tableau 43 – Structure de la connexion

Elément de trame	Champ de données	Type de données	Valeur/description
Données d'application configurables de l'esclave #k	Commande de connexion	octet[2]	Décalage dans le MDT ou AT défini par S-0-1050.x.03 (Attribution de télégrammes) de l'esclave attribué
	IDN des données d'exploitation …	octet[selon l'IDN]	Le nombre et la longueur des données d'exploitation k doivent être configurés dans S-0-1050.x.06 (Liste de configuration) ou par le télégramme standard choisi S-0-0015 (type de message).
	IDN des données d'exploitation …	octet[selon l'IDN]	
	…	…	
	IDN des données d'exploitation …	octet[selon l'IDN]	

4.7.3 Commande de connexion

La commande de connexion doit être définie comme cela est spécifié dans le Tableau 44. La commande de connexion (C-CON) constitue les deux premiers octets de chaque connexion.

Tableau 44 – Commande de connexion (C-CON)

Numéro de bit	Valeur de bit	Description
15-12		Compteur: - la valeur initiale de ce compteur est 0 en phase CP4 - chaque changement de ce compteur annonce de nouvelles données d'application dans la connexion et les données d'application peuvent être traitées - avec une connexion synchrone de cycle, ce compteur doit toujours être augmenté dans le cycle de communication associé - avec une connexion asynchrone, le changement de ce compteur déclenche un chien de garde, c'est-à-dire que, après tout changement de ce compteur, le temps de surveillance (tPcyc) redémarre toujours. Ce compteur doit être augmenté une fois par temps de surveillance (tPcyc), après que l'état "Producteur prêt" (bit 0) est réglé sur 1 - Le bit 12 doit être égal au bit 1 (nouvelles données)
11-8	—	(réservé)
7		Bit 2 en temps réel (partie intégrante des données d'application, description, voir FG_RTB)
6		Bit 1 en temps réel (partie intégrante des données d'application, description, voir FG_RTB)
5	—	(réservé)
4	—	Contrôle de flux (description, voir 4.7.4 et 4.7.5)
	0	Exécution (production et consommation sont actives)
	1	Arrêt (la production est annulée, le consommateur ne doit pas générer une erreur)
3	—	(réservé)
2	—	Retard de champ de données (le consommateur doit privilégier l'utilisation des données d'application du port auquel ce bit a la valeur 0)
	0	Aucun retard (les données d'application sont transmises sans retard dans le même cycle de communication)
	1	Retard (le maître a copié les données d'application et ces dernières sont par conséquent transmises avec un retard supplémentaire de un cycle de communication)
1	—	Nouvelles données d'application

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Numéro de bit	Valeur de bit	Description
	basculement	- la valeur initiale de ce bit est 0 en phase CP4 - chaque basculement de ce bit annonce de nouvelles données d'application dans la connexion, puis les données d'application sont échangées entre la connexion et l'application. Ceci implique que pour le consommateur - lorsque les données d'application d'un certain cycle de production n'ont pas été reçues, la valeur attendue de ce bit doit également être basculée pour le cycle de communication suivant. - avec une connexion synchrone d'horloge ou une connexion cyclique, ce bit doit toujours être basculé dans le cycle de communication associé. - avec une connexion asynchrone, ce bit déclenche un chien de garde, c'est-à-dire après la commutation de ce bit, la surveillance est toujours redémarrée avec le temps de surveillance (tPcyc). Ce bit doit être basculé une fois par temps de surveillance (tPcyc), après que l'état "Producteur prêt" (bit 0) est réglé sur 1. - Le bit 1 doit être égal au bit 12 (Bit de poids faible, LSB, du compteur).
0	—	Producteur prêt. Si le maître valide ou l'esclave valide respectivement est réglé sur 0, ce bit doit être également réglé sur 0.
	0	Non valide (le producteur ne génère encore aucune donnée d'application dans cette connexion)
	1	Valide Le producteur génère des données d'application dans cette connexion. Le consommateur peut traiter les données d'application si le producteur a basculé les nouvelles données (bit 1). Le bit "Producteur prêt" doit être évalué en phase CP4 uniquement.

Les diagrammes d'états de commande de connexion du producteur et du consommateur décrivent le comportement dynamique d'établissement et de libération des connexions. Le producteur est la partie active qui fournit des données d'application et détermine le moment d'activation ou de désactivation de la connexion. Le consommateur attend l'obtention de données d'application valides et réagit aux commutations d'état du producteur. Le producteur et le consommateur fournissent leur état de connexion dans S-0-1050.x.09 (Etat de connexion). Le producteur fournit également S-0-1050.x.08 (Commande de connexion C-CON).

4.7.4 Diagramme d'états du producteur

Outre S-0-1050.x.09 (Etat de connexion), le producteur signale son état actuel au consommateur par le réglage de bits correspondants dans la commande de connexion (C-CON). L'état initial du producteur est 'init'. A cet état, le producteur attend l'occurrence de la phase CP4. Lorsqu'il atteint cette phase, le producteur doit passer à l'état "réseau en fonctionnement (CP4)". Tant que le système est en phase CP4, le producteur doit conserver cet état. L'état "réseau en fonctionnement (CP4)" inclut un diagramme de sous-états, qui décrit l'état de production actuel du producteur. Ce dernier peut modifier ses sous-états en "préparation", "prêt", "production", "arrêt" et "attente". Si la transmission quitte la phase CP4, le diagramme d'états du producteur doit revenir à l'état 'init' (voir Figure 5).

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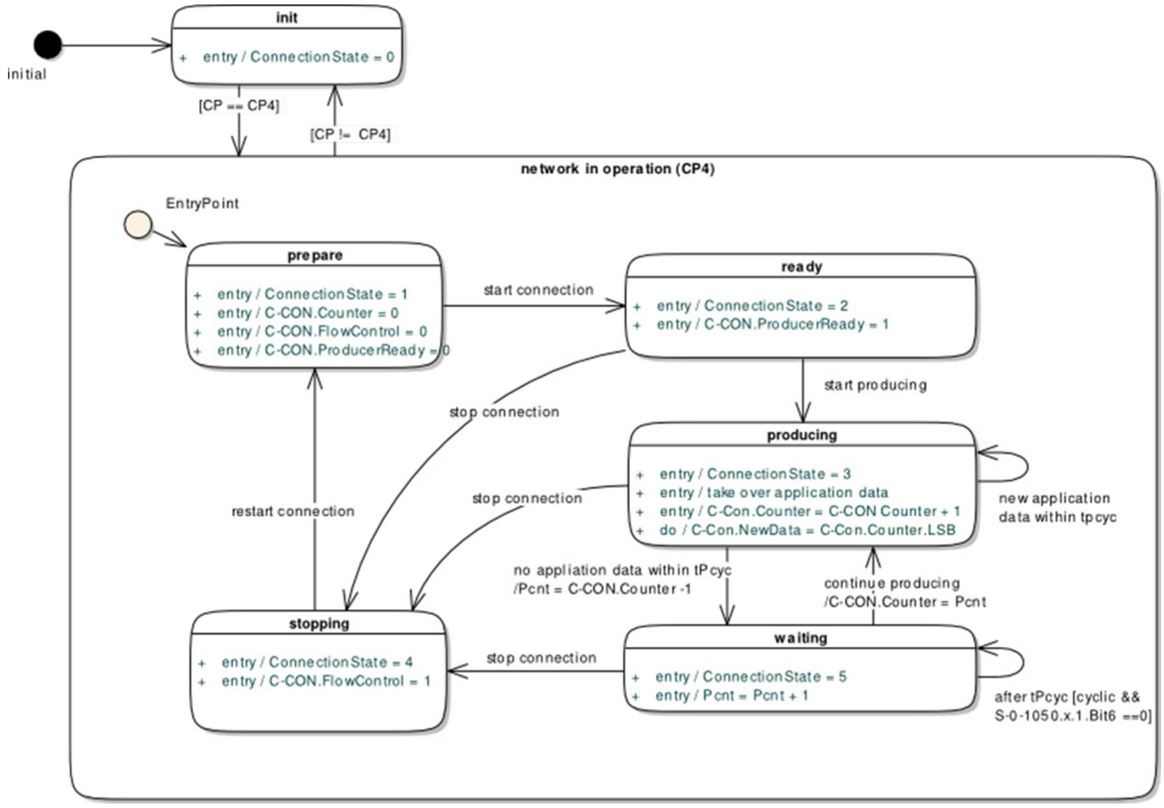

Légende

Anglais	Français
Initial	Initial
Init	Init
Entry	Entrée
Network in operation	Réseau en fonctionnement
Prepare	Préparation
Ready	Prêt
Start connection	Début de connexion
Stop connection	Arrêt de connexion
Start producing	Début de production
Producing	Production
After tPcyc[cyclic]	Après tPcyc[cyclic]
Restart connection	Relance de connexion
Suspend producing	Interrompre production
Continue producing	Poursuivre production
Stopping	Arrêt
Waiting	attente
New application data within tpcyc	Nouvelles données d'application dans tpcyc
No application data within	Pas de données d'application dans

Figure 5 – Diagramme d’états de commande de connexion du producteur

NOTE Pcnt est un compteur interne du producteur.

Le Tableau 45 présente la combinaison de bits valide de la commande de connexion dans chaque état du producteur.

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Tableau 45 – Combinaisons de commande de connexion

Etat	Nom	Commande de connexion (C-CON)		
		Producteur Prêt	Contrôle de flux	Compteur / Nouvelles données
0	Init	X	X	X
1	Préparation	0	0	0
2	Prêt	1	0	0
3	Production	1	0	+1
4	Arrêt	1	1	aucun changement
5	Attente	1	0	aucun changement

Le Tableau 46 présente les états du diagramme d'états du producteur.

Tableau 46 – Etats du diagramme d'états du producteur

Etat	Description
Init	En lançant le diagramme d'états, le producteur doit démarrer et conserver cet état tant que la phase de communication n'est pas CP4. En entrant dans cet état, l'état de connexion doit être réglé sur 0. Les connexions sont configurées par le maître ou le configurateur et vérifiées par les esclaves.
Réseau en fonctionnement (CP4)	Dans cet état, la phase de communication est CP4 et le producteur traite le diagramme de sous-états en fonction des données d'application.

Le Tableau 47 présente les états du diagramme de sous-états du producteur.

Tableau 47 – Etats du diagramme de sous-états du producteur

Etat	Description
Préparation	Dans cet état, le producteur prépare la connexion. En entrant dans l'état "préparation", le producteur doit réinitialiser les bits de commande de connexion C-CON.FlowControl, C-CON.ProducerReady et C-CON.Counter sur 0. L'état de connexion doit être réglé sur 1. Après avoir préparé la connexion, le producteur est autorisé à lancer la connexion et à passer à l'état "prêt".
Prêt	Le producteur est prêt à transmettre des données d'application et doit régler le bit de commande de connexion C-CON.ProducerReady sur 1. En entrant dans cet état, l'état de connexion doit être réglé sur 2. Le producteur doit passer à l'état "production" en fonction de l'application. NOTE Aussi rapidement que possible, l'application doit commencer la production indépendamment de l'état de toutes les connexions du consommateur
Production	Dans cet état, le producteur doit fournir des données d'application valides et doit augmenter de 1 le C.CON.Counter tel que configuré dans S-0-1050.x.01. Le C-CON.NewData est réglé sur le bit de poids faible C-CON.Counter.LSB. En entrant dans cet état, l'état de connexion doit être réglé sur 3.
Attente	Le producteur attend de nouvelles données d'application. Le compteur Pcnt est initialisé avec le C-CON.Counter – 1. En entrant dans cet état, le compteur interne Pcnt du producteur est augmenté de 1 dans chaque cycle de production tel que configuré dans S-0-1050.x.01. L'état de connexion doit être réglé sur 4.
Arrêt	Le producteur ne produit plus de données d'application. En entrant dans cet état, le bit de commande de connexion C.CON.FlowControl doit être réglé sur 1 et les données d'application deviennent non valides. L'état de connexion doit être réglé sur 5.

Les transitions du producteur peuvent être décrites comme suit:

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Tableau 48 – Transitions du producteur

Transition			Description
Source	**Cible**	**Condition**	
Init	Réseau en fonctionnement (CP4)	CP == CP4	Si la transmission atteint la phase CP4, le producteur doit alors passer de l'état "init" à l'état "réseau en fonctionnement (CP4)". Le diagramme de sous-états "réseau en fonctionnement (CP4)" commence avec le sous-état "préparation".
Réseau en fonctionnement (CP4)	Init	CP != CP4	Si la transmission quitte la phase CP4, le producteur doit alors passer à l'état "init".
Préparation	Prêt	Début de la connexion	Le producteur est prêt à transmettre des données d'application et commute sur l'état "prêt" de manière autonome.
Prêt	Production	Début de la production	Le producteur reprend de nouvelles données d'application.
Production	Production	TPcyc	Dans chaque durée de cycle de production (tPcyc), le producteur commence à produire des données d'application et demeure dans l'état ''production''.
Production	Attente	Aucune nouvelle donnée d'application	Le producteur n'a pas reçu de nouvelles données d'application dans ce cycle de production et doit copier le C.CON.Counter - 1 sur Pcnt. Le producteur doit commuter sur l'état ''attente''.
Attente	Attente	Après tPcyc	Dans chaque durée de cycle de production (tPcyc) et S-0-1050.x.01, bit 6 = 0 (avec prévision), le producteur augmente le Pcnt de 1 et demeure dans l'état ''attente''.
Attente	Production	Poursuite de la production	Le producteur reçoit de nouvelles données d'application, poursuit la production et doit copier le Pcnt sur le C.CON.Counter.
Prêt	Arrêt	Arrêt de la connexion	Le producteur arrête la connexion et commute sur l'état "arrêt". Il faut que la connexion soit relancée pour produire à nouveau des données d'application.
Production	Arrêt	Arrêt de la connexion	Le producteur cesse de produire des données d'application et commute sur l'état "arrêt". Il faut que la connexion soit relancée pour produire à nouveau des données d'application.
Attente	Arrêt	Arrêt de la connexion	Le producteur arrête la connexion et commute sur l'état "arrêt". Le producteur doit régler le bit de commande C-CON.FlowControl sur1. La connexion doit être relancée pour produire à nouveau des données d'application
Arrêt	Préparation	Relance de la connexion	Le producteur relance la connexion et commute sur l'état "préparation".

4.7.5 Diagramme d'états du consommateur

L'état initial du consommateur est 'init' (Figure 6). Dans cet état, le consommateur doit attendre jusqu'à ce que la communication passe à CP4. Si tel est le cas, le consommateur doit passer à l'état "réseau en fonctionnement (CP4)" et faire passer le diagramme de sous-états du consommateur dans l'état "préparation". Les autres commutations d'état du consommateur sont pilotées par le producteur. Le consommateur réagit au changement des bits de commande de connexion (C.CON) du producteur, ou la transmission quitte la phase CP4. La seule exception est le rétablissement de l'état "erreur" à l'état "préparation", qui peut être déclenché par l'exécution de la commande de procédure S-0-099 (Diagnostic de classe 1 de réinitialisation).

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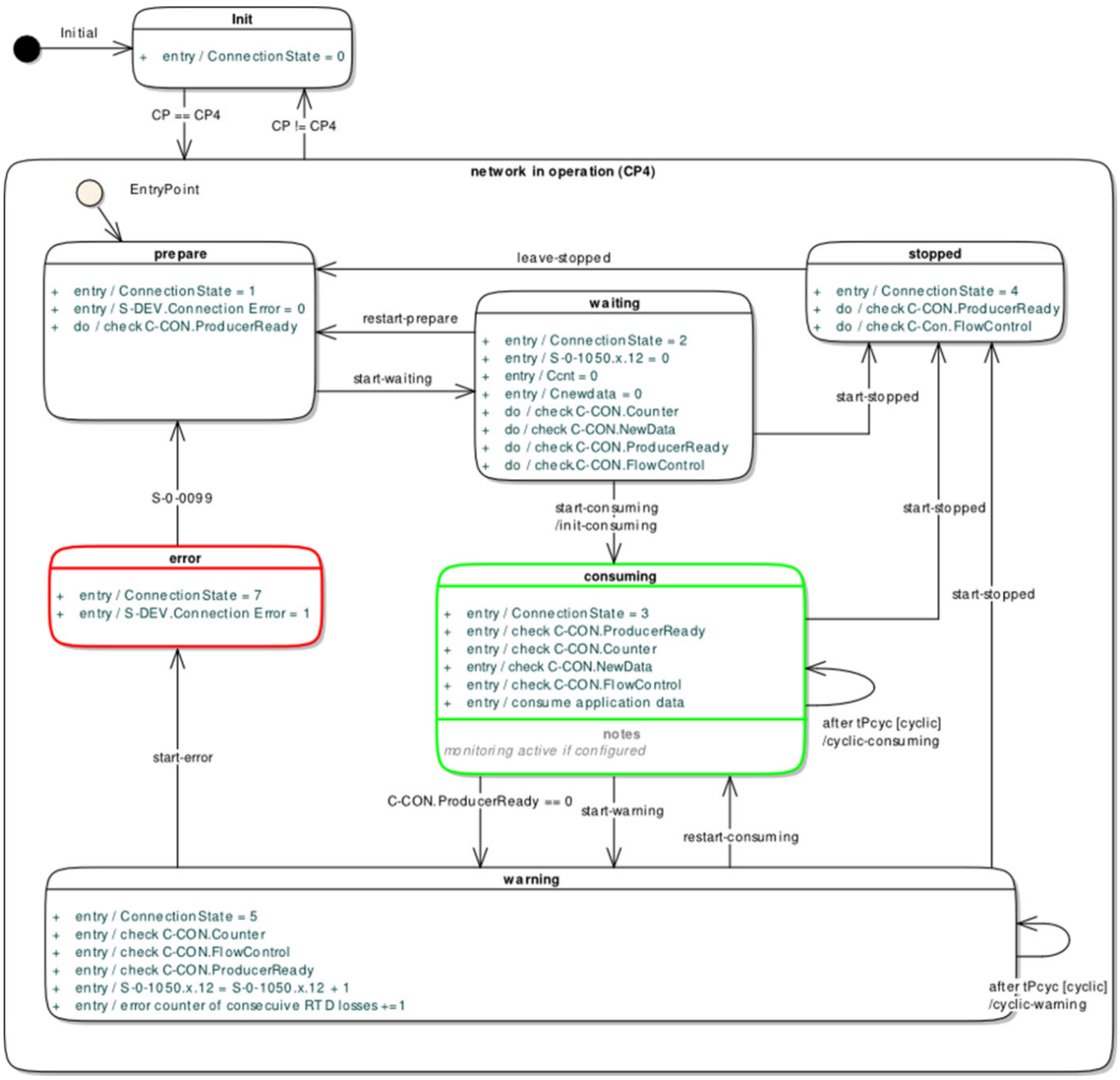
La procédure normale de consommation des données d'application consiste à commuter de l'état "préparation" à l'état "consommation" en passant par l'état "attente". L'état "arrêt" permet d'arrêter et de relancer un consommateur dans l'état "consommation". En cas de pertes de données d'application, le consommateur doit commuter de l'état ''consommation'' sur l'état "avertissement" et augmente le S-0-1050.x.12 (Pertes de données des compteurs d'erreurs). En cas d'erreurs, le consommateur doit commuter de l'état ''avertissement'' sur l'état ''erreur''. Le consommateur doit signaler les erreurs au moyen du bit d'état d'appareil S-DEV.ConnError.



Légende

Anglais	Français
Initial	Initial
Init	Init
Entry	Entrée
Network in operation	Réseau en fonctionnement
Prepare	Préparation
Stopped	Arrêt – arrêté
Waiting	Attente
Reset	Réinitialisation

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Anglais	Français
Error	Erreur
Consuming	Consommation
After tPcyc[cyclic]	Après tPcyc[cyclic]
amount of consecutive data losses	nombre de pertes de données consécutives
Warning	Avertissement
Start-waiting	Démarrage-attente
Restart-prepare	Redémarrage-préparation
Start-stopped	Démarrage-arrêt
Start-consuming	Démarrage-consommation
Init-consuming	Init-consommation
Start-error	Démarrage-erreur
Start-warning	Démarrage-avertissement
Restart-consuming	Redémarrage-consommation
Leave-stopped	Abandon-arrêt

Figure 6 – Diagramme d'états de commande de connexion de consommateur

NOTE 1 Ccnt est un compteur interne du consommateur et sert à vérifier le C-CON.Counter.

NOTE 2 Cnewdata est un bit interne du consommateur et sert à vérifier le C-CON.NewData.

Le Tableau 49 et le Tableau 50 présentent les états du diagramme d'états du consommateur et le diagramme de sous-états du consommateur.

Tableau 49 – Etats du diagramme d'états du consommateur

Etat	Description
Init	En lançant le diagramme d'états, le consommateur doit initier et conserver cet état tant que la phase de communication n'est pas CP4. En entrant dans cet état, l'état de connexion doit être réglé sur 0. Les connexions sont configurées par le maître ou le configurateur et vérifiées par les esclaves.
réseau en fonctionnement (CP4)	Dans cet état, la phase de communication est CP4 et le consommateur réagit aux informations fournies par le producteur. Si la transmission quitte la phase CP4, le consommateur passe alors sur 'init'.

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Tableau 50 – Etats du diagramme de sous-états du consommateur

Etat	Description
préparation	Le consommateur prépare la connexion, doit régler l'état de connexion sur 1 et doit réinitialiser le bit d'état d'appareil (S-DEV.Connection Error) sur 0. Le consommateur doit vérifier le bit C.CON.Producer-ready
attente	En entrant dans cet état, l'état de connexion doit être réglé sur 2, et S-0-1050.x.12 (Pertes de données des compteurs d'erreurs) et le bit interne Cnewdata du consommateur et counter Cnt respectivement, doivent être réglés sur 0. Dans cet état, le consommateur doit vérifier la commande de connexion (C.CON) définie comme suit: - Le consommateur doit vérifier C-CON.Counter et C-CON.NewData pour déterminer si le C-CON.Counter est pris en charge par le producteur. Si c'est le cas, le consommateur doit alors utiliser le C-CON.Counter pour seulement le diagramme d'états du consommateur. - Le consommateur doit vérifier le C-CON.ProducerReady. - Le consommateur doit vérifier le C-CON.FlowControl.
consommation	A l'état "consommation", l'état de connexion doit être réglé sur 3 et les données d'application du producteur doivent être consommées par le consommateur. De plus, le consommateur doit vérifier la commande de connexion (C.CON) définie comme suit: - Si le producteur annule la production et règle le bit de commande C-CON.ProducerReady sur zéro (C-CON.ProducerReady = 0), les données d'application deviennent alors non valides et le consommateur ne doit pas les consommer. - le consommateur doit vérifier le C-CON.FlowControl. - Si l'attente correspondante en ce qui concerne la méthode configurée n'est pas satisfaite, le consommateur reconnaît alors les pertes de données d'application dans ce cycle de production et ne doit pas consommer les données d'application. - Pour le consommateur non synchrone avec chien de garde: si le consommateur évalue le C.CON.Counter dans une fréquence de son contrôle modulo (16 fois), le consommateur reconnaît alors les pertes de données d'application. - Si l'attente correspondante en ce qui concerne la méthode configurée en S-0-1050.x.01, bit 6, est satisfaite, le consommateur doit alors consommer les données d'application. - Le ''compteur d'erreurs de pertes de données consécutives'' interne doit être réglé sur 0, en cas de détection d'un changement de C-CON.NewData ou C-CON.Con-counter.
avertissement	Dans l'état "avertissement", l'état de connexion doit être réglé sur 5. De plus, le consommateur doit vérifier la commande de connexion (C.CON) définie comme suit: - Le consommateur doit vérifier C-CON.FlowControl. - Le consommateur doit augmenter S-0-1050.x.12 (Pertes de données des compteurs d'erreurs) de 1 dans chaque cycle de production (tPcyc). - Le consommateur doit augmenter le ''compteur d'erreurs de pertes de données consécutives '' interne de 1 dans chaque cycle de production (tPcyc). - Si C-CON.ProducerReady = 0, le consommateur interrompt alors la consommation et attend jusqu'à ce que C-CON.ProducerReady soit de nouveau réglé sur 1 par le producteur. - Le consommateur doit vérifier si le ''compteur d'erreurs de pertes de données consécutives '' interne dépasse S-0-1050.x.11 (Pertes de données admises). - Le consommateur doit vérifier si le ''compteur d'erreurs de pertes de données consécutives '' interne n'a pas dépassé S-0-1050.x.11 (Pertes de données admises) et si les données d'application redeviennent valides (C-CON.ProducerReady = 1).
arrêt	Dans cet état, l'état de connexion doit être réglé sur 4 et le consommateur doit attendre le redémarrage de la connexion. Le consommateur doit vérifier le C-CON.ProducerReady et le C-CON.FlowControl.
erreur	Dans cet état, l'état de connexion doit être réglé sur 7 et le consommateur doit régler le bit d'état d'appareil S-DEV.ConnError sur 1 et régler S-0-0390 (Numéro de diagnostic) sur 0xC30F4002. Le consommateur doit vérifier si S-0-0099 (Diagnostic de classe 1 de réinitialisation) est activé.

Le Tableau 51 présente les transitions du consommateur.

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Tableau 51 – Transitions du consommateur

Transition			Description
Source	**Cible**	**Condition**	
Init	réseau en fonctionnement (CP4) état = préparation	CP == CP4	Si la transmission atteint la phase CP4, le consommateur doit alors commuter sur l'état "réseau en fonctionnement (CP4)". Le diagramme de sous-états commence par le sous-état "préparation".
réseau en fonctionnement (CP4)	Init	CP != CP4	Si la transmission quitte la phase CP4, le consommateur doit alors commuter sur l'état 'init'.
préparation	attente	démarrage-attente C.CON.ProducerReady == 1	Si le C.CON.ProducerReady est réglé sur 1, le consommateur doit alors commuter sur l'état "attente"
attente	préparation	redémarrage-préparation C.CON.ProducerReady == 0	Si le C.CON.ProducerReady est réglé sur 0 sur les deux ports (P1 et P2), le consommateur doit alors commuter sur l'état "préparation". Tous autres bits dans le C-CON sont étiquetés ''don't care''.
attente	Arrêt	démarrage-arrêt C-CON.ProducerReady == 1 && C-CON.FlowControl == 1	Le producteur arrête la connexion en réglant C.CON.FlowControl sur 1 et le the C-CON.ProducerReady sur 1. Dans ce cas, le consommateur doit commuter sur l'état "arrêt".
avertissement	Arrêt	démarrage-arrêt C-CON.ProducerReady == 1 && C.CON.FlowControl == 1	Le producteur arrête la connexion en réglant C.CON.FlowControl sur 1. Dans ce cas, le consommateur doit commuter sur l'état "arrêt".
consommation	Arrêt	démarrage-arrêt C-CON.ProducerReady == 1 && C.CON.FlowControl == 1	Le producteur arrête la connexion en réglant C.CON.FlowControl sur 1. Dans ce cas, le consommateur doit commuter sur l'état "arrêt".
arrêt	préparation	abandon-arrêt C-CON.ProducerReady == 0 ou C-CON.FlowControl == 0	Le producteur redémarre la connexion en réglant C.CON.ProducerReady sur 0. Dans ce cas, le consommateur doit commuter sur l'état "préparation".
consommation	avertissement	C-CON.ProducerReady == 0 (doit être rempli sur les deux ports)	Si le C.CON.ProducerReady est réglé sur 0 sur les deux ports (P1 et P2) pendant la consommation, le consommateur ne reçoit plus donc de données d'application valides et doit commuter sur l'état "avertissement". Tous autres bits dans le C-CON sont étiquetés ''don't care''.
avertissement	Erreur	démarrage-erreur ("compteur d'erreurs de pertes de données consécutives'' interne) > S-0-1050.x.11 11 Pertes de données admises	Si C-CON.ProducerReady est égal à 1 et C-CON.FlowControl est égal à 0 et le ''compteur d'erreurs de pertes de données consécutives'' interne dépasse S-0-1050.x.11 (Pertes de données admises), le consommateur doit alors commuter sur l'état "erreur".
erreur	préparation	S-0-0099 Diagnostic de classe 1 de réinitialisation	L'erreur est réinitialisée avec l'exécution de S-0-0099 (Diagnostic de classe 1 de réinitialisation). Le consommateur doit régler le bit d'état d'appareil S-DEV.ConnError sur 0 et doit commuter sur l'état "préparation".
attente	consommation	démarrage-consommation (init-consommation) C-CON.ProducerReady==1 && C-CON.FlowControl==0	C-CON.NewData!=Cnewdata: Si C-CON.NewData ≠ Cnewdata, le consommateur doit alors initialiser le bit interne Cnewdata = C-CON.NewData et commuter sur l'état ''consommation''. C-CON.Counter!=Ccnt: Si C-CON.Counter ≠ Ccnt, le consommateur doit alors initialiser le compteur interne Ccnt = C-CON.Counter et commuter sur l'état ''consommation''.
avertissement	consommation	C.CON.Counter != CNT && C.CON.ProducerReady == 1	Le producteur génère une nouvelle fois des données d'application valides et le nombre de pertes RTD consécutives n'a pas dépassé S-0-1050.x.11 (Pertes de données admises), le consommateur commute

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Transition			Description
Source	Cible	Condition	
			alors sur l'état "consommation".
consommation	consommation	après consommation cyclique tPcyc C-CON.ProducerReady == 1 && C-CON.FlowControl == 0	Si C-CON.ProducerReady est égal à 1 et C-CON.FlowControl est égal à 0, le consommateur consomme alors les données d'application dans chaque durée de cycle de production (tPcyc) et conserve l'état "consommation".
consommation	avertissement	démarrage-avertissement C-CON.ProducerReady == 1 && C-CON.FlowControl == 0	Si la vérification de C-CON.NewData a été erronée, le producteur n'augmente alors pas le C-CON.NewData correctement. Dans ce cas, les données d'application ne sont pas valides et le consommateur doit commuter sur l'état "avertissement". Si la vérification de C.CON.Counter a été erronée, le producteur n'augmente alors pas le C-CON.Counter correctement. Dans ce cas, les données d'application ne sont pas valides et le consommateur doit commuter sur l'état "avertissement".
avertissement	avertissement	après avertissement cyclique tPcyc C-CON.ProducerReady == 0	Si C-CON.ProducerReady est égal à 0, le consommateur doit alors augmenter le S-0-1050.x.12 (Pertes de données des compteurs d'erreurs) et le ''compteur d'erreurs de pertes de données consécutives'' interne de 1 dans chaque durée de cycle de production (tPcyc). Le consommateur conserve l'état "avertissement".
avertissement	consommation	redémarrage-consommation C-CON.ProducerReady == 1 && C-CON.FlowControl == 0	Si le producteur génère une nouvelle fois des données d'application (C-CON.ProducerReady est égal à 1 et C-CON.FlowControl est égal à 0) et le ''compteur d'erreurs de pertes de données consécutives'' interne n'a pas dépassé S-0-1050.x.11 (Pertes de données admises), le consommateur commute alors sur l'état "consommation". La condition suivante doit correspondre aux attentes.

5 Gestion de DL

5.1 Présentation générale

Les procédures de gestion de DL sont traitées de manière fonctionnelle en réponse à des demandes de service de gestion de DL soumises par l'utilisateur DL et aux événements provoqués par le réseau.

5.2 Initialisation d'une transmission cyclique

5.2.1 Introduction

Le passage en majuscules communément appelé passage en majuscules de phase est déclenché sur une demande Initiate_cyclic_communication (ICC) par l'utilisateur DL dans l'appareil maître.

Le passage en majuscules de phase réussi entraîne la génération d'une indication Notify_cyclic_communication (NCC) pour l'utilisateur DL dans l'appareil esclave.

Le passage en minuscules communément appelé passage en minuscules de phase est déclenché sur une demande Disable_cyclic_communication (DCC) par l'utilisateur DL dans l'appareil maître.

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La désactivation de la transmission cyclique entraîne la génération d'une indication Notify_cyclic_communication_disabled (NCCD) pour l'utilisateur DL dans l'appareil esclave.

L'occurrence d'une erreur dans la transmission cyclique génère une indication Notify_error (NER) pour l'utilisateur DL dans un appareil maître et un appareil esclave.

5.2.2 Phases de communication (CP)

5.2.2.1 Généralités

L'initialisation doit être divisée en cinq phases de communication et en état NRT:

a) Après mise sous tension d'une station, et réalisation de contrôles internes sans erreur, ladite station doit fonctionner en état temps différé (NRT) (voir 5.2.2.2);

b) L'initialisation d'un réseau de Type 19 doit toujours commencer avec CP0;

c) La CP0 doit être utilisée pour la reconnaissance des esclaves participants;

d) La CP1 doit être utilisée pour la configuration des appareils esclaves pour une transmission non cyclique;

e) La CP2 doit être utilisée pour la configuration des appareils esclaves pour une transmission cyclique et pour le réglage des paramètres dans l'esclave via une transmission non cyclique;

f) La CP3 doit être utilisée pour la configuration ultérieure des appareils esclaves, la transmission cyclique doit déjà fonctionner, mais ne doit pas être utilisée;

g) En phase CP4, le processus d'initialisation est achevé et le réseau de Type 19 doit être en fonctionnement normal.

Il doit également être possible d'adopter la phase CP0 à partir de toute phase supérieure. Il ne doit pas être possible d'adopter d'autres phases, sauf au moment de la sortie de la phase précédente dans l'ordre ascendant.

Le maître doit déclencher une CP spécifique par réglage de la phase MDT dans les DLPDU de Type 19 (voir 4.5.4). Les esclaves doivent suivre en conséquence. Les esclaves doivent commuter sur l'état NRT uniquement en cas d'erreur de communication.

Lorsqu'un esclave est connecté à un réseau déjà opérationnel, et reçoit un MST qui indique CP4, il doit alors adopter la procédure de connexion à chaud (voir 5.5) si elle est prise en charge. Sinon, l'esclave conserve l'état NRT.

Le diagramme d'états des phases de communication est présenté à gauche dans la Figure 7 .

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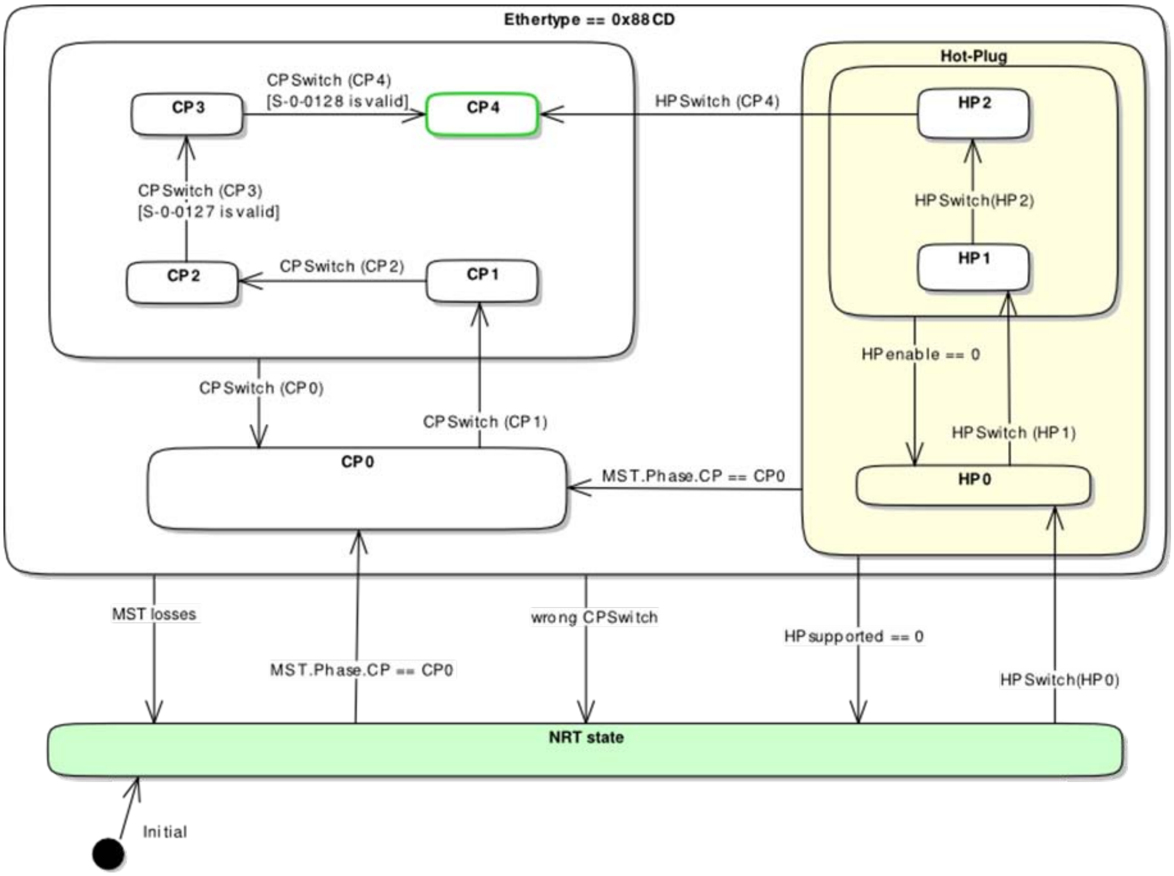

Légende

Anglais	Français
S-0-0128 is valid	S-0-0128 est valide
S-0-01278 is valid	S-0-0127 est valide
Hot-Plug	Hot-Plug (connexion à chaud)
MST losses	Pertes MST
HP enable	HP actif
Wrong CPSwitch	CPSwitch erroné
HP supported	HP prise en charge
NRT mode	Mode NRT
HP Switch	Commutateur HP

Figure 7 – Diagramme d'états des phases de communication (CP)

5.2.2.2 Etats du diagramme d'états des CP

5.2.2.2.1 Généralités

Les états du diagramme d'états des CP sont décrits dans en 5.2.2.2.2 (état NRT), 5.2.2.2.3 (CP0), 5.2.2.2.4 (CP1), 5.2.2.2.5 (CP2), 5.2.2.2.6 (CP3) et 5.2.2.2.7 (CP4). La configuration des DEL doit être ajustée sur les états de communication correspondants.

5.2.2.2.2 Etat en temps différé (NRT)

A leur mise sous tension, le maître et chaque esclave doivent activer l'état NRT de manière indépendante.

Le mode NRT est activé pendant l'état NRT.

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La mémoire tampon de collision doit être administrée tel que décrit dans le diagramme d'états de topologie.

Le maître doit quitter l'état NRT pour CP0 sur demande de son utilisateur DL.

L'esclave doit vérifier le MST des télégrammes de Type 19. Lorsque l'esclave reconnaît un MST avec CP = 0, il doit alors activer CP0 et modifier la topologie. Lorsqu'un esclave reconnaît un MST avec CP = 4, il doit alors activer HP0, si la connexion à chaud est prise en charge.

Avant d'entrer dans l'état NRT à partir d'un état différent de CP0 ou HP0, l'esclave doit générer une liaison descendante sur les deux ports.

Dans l'état NRT, l'esclave peut activer la configuration #1 des DEL de Type 19.

5.2.2.2.3 Phase de communication(CP0)

En phase CP0, le maître doit transmettre MDT0 et AT0 tel que spécifié sur un ou ses deux ports, selon la topologie donnée, afin de

- vérifier la topologie (par exemple, vérifier si le réseau est établi);
- vérifier si tous les esclaves exigés par l'application sont présents dans le réseau.

L'esclave doit:

- vérifier la version de communication;
- prendre en charge l'attribution d'adresses;
- modifier automatiquement l'état de topologie selon le MST reçu, au temps T7cp0 entre
  - l'état NRT (la fonctionnalité store&forward ou cut-through),
  - l'état RT (le bouclage avec acheminement et acheminement rapide).

5.2.2.2.4 Phase de communication 1 (CP1)

Les index de topologie déterminés en phase CP0 permettent l'adressage des voies de service en phase CP1.

En phase CP1, le maître doit initialiser les voies de service de tous les esclaves identifiés de la phase CP0.

Au cours de la procédure de demande, le maître doit transmettre MDT0 et MDT1 (ainsi que MDT2 et MDT3, lorsque plus de 255 esclaves sont identifiés) et définir MHS = 1 dans la commande SVC afin de demander à chaque esclave utilisé d'intégrer les données dans l'AT correspondant. AT0 et AT1 (ainsi que AT2 et AT3, lorsque plus de 255 esclaves sont identifiés) doivent être transmis par le maître avec un champ de données AT attribué (contenu réglé sur 0).

Dans la commande d'appareil, le maître doit ajuster les bits suivants et tous les esclaves identifiés doivent les évaluer :

- C-DEV.identification (C-DEV.identification)
- C-DEV.topology (C-DEV.topologie)
- C-DEV.status physical topology (C-DEV.topologie physique d'état), seulement si le canal UC est pris en charge.

Si C.DEV.Master valid = 1 dans la phase CP1, tous les esclaves doivent alors évaluer la C-DEV dans CP2 à CP4 seulement si C-DEV.Master valid est réglé sur 1. Si C.DEV.Master

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valid = 0 dans CP1, ce bit n'est donc pas pris en charge par le maître et l'esclave doit évaluer la C-DEV dans CP2 à CP4 également si C-DEV.Master valid est réglé sur 0.

Au cours de la procédure de demande, la séquence suivante doit être observée par le maître et tous les esclaves identifiés:

a) En premier lieu, l'esclave doit définir Slave valid (Esclave valide) = 1 dans l'état d'appareil pour indiquer la disponibilité dans la topologie.
b) Si l'esclave est prêt pour communiquer via SVC, il doit alors définir Esclave valide = 1 dans l'état SVC correspondant.
c) Ensuite, le maître doit définir MHS = 1 dans la commande SVC correspondante.
d) Si un esclave répond avec AHS=1 dans l'état SVC dans le cadre de la temporisation de protocole (10 cycles de communication), alors SVC est correctement initialisé.
e) Si un esclave ne répond pas avec AHS=1 dans l'état SVC dans le cadre de la temporisation de protocole, le maître doit alors générer un message d'erreur et passe à la phase CP0.

Dans l'état d'appareil, l'esclave doit ajuster les bits suivants et le maître doit les évaluer, si S-DEV.Slave valid = 1:

- S-DEV.Slave valid=1 (S.DEV.esclave valide =1)
- S-DEV.topology (S-DEV.topologie)
- S-DEV.parameterization level (S-DEV.niveau de paramétrage)
- S-DEV.communication warning interface (S-DEV.interface d'avertissement de communication)
- S-DEV.C1D error of device (S-DEV.C1D erreur d'appareil)
- S-DEV.C2D warning of device (S-DEV.C2D avertissement d'appareil)

Tous les esclaves identifiés doivent se comporter tel que décrit ici, y compris ceux avec l'adresse de sous-appareil (S-0-1040) = 0.

5.2.2.2.5 Phase de communication 2 (CP2)

En phase CP2, les esclaves doivent être adressés de manière spécifique, en utilisant leur voie de service correspondante. Pour la phase CP2 et les phases suivantes, ces esclaves doivent prendre en charge la fonctionnalité de voie de service complète.

Le maître doit transmettre à tous les esclaves présents au minimum les éléments suivants:

- les paramètres de communication requis pour les phases CP3 et CP4;
- la longueur de tous les MDT et AT;
- les décalages de leur voie de service et des données en temps réel.

Dans la commande d'appareil (C-DEV), le maître doit ajuster les bits suivants et tous les esclaves présents doivent les évaluer, si C-DEV.Master valid est égal à CP1:

- C-DEV.Master valid = C-DEV.Master valid de CP1
- C-DEV.Identification (C-DEV.identification)
- C-DEV.Topology (C-DEV.Topologie)
- C-DEV.Status physical topology (C-DEV.Topologie physique d'état), seulement si le canal UC est pris en charge.

Dans l'état d'appareil, l'esclave doit ajuster les bits suivants et le maître doit les évaluer, si Slave valid (Esclave valide) = 1:

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- S-DEV.Slave valid (S-DEV.C1D Esclave valide=1)
- S-DEV.Topology (S-DEV.Topologie)
- S-DEV.Parameterization level (S-DEV.Niveau de paramétrage)
- S-DEV.Communication warning interface (S-DEV.Interface d'avertissement de communication)
- S-DEV.C1D error in device (S-DEV.C1D erreur d'appareil)
- S-DEV.C2D warning in device (S-DEV.C2D avertissement d'appareil)
- S-DEV.procedure command change bit (S-DEV.bit de changement de commande de procédure)

L'intégralité de l'échange d'informations s'effectue par l'intermédiaire des mécanismes de la voie de service (voir 6.2). La fiabilité de transmission doit être garantie par les bits MHS et AHS, ainsi que la temporisation HS. D'autres échanges de paramètres peuvent se produire en phase CP2 ou CP3.

Le maître doit transmettre les retards d'anneau et activer la commande de procédure S-0-1024 (mesure de retard SYNC) de tous les esclaves, qui doivent être synchronisés. Les esclaves doivent ajuster le temps de synchronisation selon les retards d'anneau.

Lorsque le maître définit t6 = 0, le canal UC est désactivé en phases CP3 et CP4, et le temps t7 est 'don't care'.

La transition entre les phases CP2 et CP3 doit s'effectuer selon la procédure suivante:

a) Le maître doit activer la commande de procédure S-0-0127 (contrôle de transition de CP3) telle que définie.
b) L'esclave doit alors déterminer la validité des paramètres pour CP3. Le contrôle de la validité des paramètres par l'esclave doit se rapporter aux seuls critères généraux (par exemple, minimal, maximal). Il ne doit pas être en mesure de déterminer si tous les paramètres transmis par le maître sont corrects par rapport aux données en temps réel de ce dernier et à l'ensemble de l'installation. Cela signifie que, même si un esclave acquitte positivement le "contrôle de transition de CP3", il peut y avoir des paramètres de transmission incorrects par rapport à l'ensemble de l'installation, ce qui peut conduire à une interruption de la transmission.
c) Si l'esclave détecte une erreur, il doit alors poursuivre le processus avec la ''Procédure avec erreur''. Si, après le traitement de la procédure de commande, il reste encore des paramètres invalides supplémentaires, l'esclave doit
   - archiver les IDN des données non valides dans S-0-0021 (liste des IDN des données d'exploitation non valides pour CP2) et doit
   - répondre avec l'acquittement de la commande de procédure: ''Erreur, exécution de la commande de procédure impossible''.

   Après acquittement négatif de la commande de procédure,

   - le maître peut lire les paramètres de diagnostic (par exemple, S-0-0021, S-0-0390 Numéro de diagnostic...) et afficher un message d'erreur.
   - Avant que le maître n'active une nouvelle fois le S-0-0127 (contrôle de transition de CP3), il doit supprimer cette commande de procédure dans l'esclave.
   - Dans ce cas d'anomalie, le maître doit rester en phase CP2 et, selon ses capacités, réessayer de définir les paramètres identifiés comme non valides ou envoyer un message d'erreur afin de permettre une initialisation ultérieure par intervention de l'opérateur.

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Après que le maître a saisi d'autres paramètres protégés en écriture en phase CP3 selon leur attribut, la commande de procédure S-0-0127 (Contrôle de transition de CP3) doit être activée une nouvelle fois.

d) Si l'esclave ne détecte aucune erreur, il doit alors continuer le processus avec la ‘’Procédure sans erreur’’

- L'esclave doit acquitter la commande de procédure de manière positive (par exemple, "Commande de procédure exécutée correctement") et définir CPS ready (CPS prêt) = 1.
- Après réception de l'acquittement positif de la commande de procédure, le maître doit supprimer la commande de procédure interne à l'esclave.
- Avec des paramètres de longueur variable qui peuvent être configurés également comme des données d'application, l'indicateur de longueur actuelle ne doit plus être modifié.
- Si le maître a saisi d'autres paramètres protégés en écriture en phase CP3, après l'acquittement positif de la commande de procédure, l'esclave doit alors définir CPS prêt = 0 et le maître doit répéter la commande de procédure S-0-0127 (Contrôle de transition de CP3) une nouvelle fois.
- Autrement, le maître peut alors déclencher la commutation sur CP3 (voir 5.2.3).

5.2.2.2.6 Phase de communication 3 (CP3)

En commençant à la phase CP3, l'échange des données en temps réel doit s'effectuer via les télégrammes définis pour CP4. Le maître doit transmettre les MDT et AT configurés à tous les esclaves.

Pour prendre en charge la commutation IP, le maître doit transmettre les paramètres du créneau du canal UC dans le champ HP MDT à l'aide de l'adresse de diffusion. Le maître doit, directement après le début de la phase CP3 et immédiatement après récupération de l'anneau, transmettre t6 et t7 avec les cycles d'analyse définis de chaque paramètre. Le contenu du champ HP MDT est présenté au Tableau 52.

Tableau 52 – Champ de connexion à chaud MDT en phase CP3 après récupération de l'anneau

Adresse de sous-appareil	commande HP	INFO HP MDT	Cycles d'analyse de chaque paramètre
4095 (diffusion)	0x02 (codage de t6)	Valeur de t6 (début du canal UC)	tScyc ≤ 2ms --> cycles d'analyse= (2ms/tScyc) * 10 cycles tScyc > 2ms --> cycles d'analyse= 10 cycles
4095 (diffusion)	0x03 (codage de t7)	Valeur de t7 (fin du canal UC)	tScyc ≤ 2ms --> cycles d'analyse = (2ms/tScyc) * 10 cycles tScyc > 2ms --> cycles d'analyse= 10 cycles

Pendant la phase CP3, le maître peut transmettre des paramètres d'application (par exemple, limites, seuils, paramètres de machines, etc.) destinés aux esclaves, via la voie de service. La fiabilité de transmission pour la voie de service doit être garantie par la commande SVC, l'état SVC, ainsi que la temporisation HS.

En phase CP3, le profil spécifique à la fonction peut être activé.

La transition entre les phases CP3 et CP4 doit s'effectuer selon la procédure suivante:

a) Le maître doit activer la commande de procédure S-0-0128 (contrôle de transition de CP4) telle que définie.

b) L'esclave doit alors déterminer la validité des paramètres pour CP4.

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c) Ensuite, l'esclave doit exécuter le traitement des paramètres requis pour le fonctionnement de l'esclave.

d) L'esclave doit alors activer la synchronisation.

- Si l'esclave détecte une erreur, il doit alors poursuivre le processus avec la ‘’Procédure avec erreur’’.

e) Si, après le traitement de la procédure de commande, il reste encore des paramètres invalides supplémentaires, l’esclave doit:

- archiver les IDN des données non valides dans S-0-0022 (liste des IDN de données d'exploitation invalides pour CP3) et doit
- répondre avec l’acquittement de la commande de procédure: "Erreur: exécution de la commande de procédure impossible".

Après acquittement négatif de la commande de procédure,

- le maître peut lire les paramètres de diagnostic (par exemple, S-0-0022, S-0-0390 Numéro de diagnostic...) et afficher un message d'erreur.
- Avant que le maître n’active une nouvelle fois le S-0-0128 (contrôle de transition de CP4), il doit supprimer cette commande de procédure dans l’esclave.
- Dans ce cas d'anomalie, le maître doit rester en phase CP3 et, selon ses capacités, réessayer de redéfinir les paramètres identifiés comme non valides ou envoyer un message d'erreur spécifiant qu'une intervention humaine (par exemple, l'opérateur) est requise.

Après que le maître a saisi d’autres paramètres (selon S-0-0022 liste des IDN de données d'exploitation invalides pour CP3) dans l'esclave en phase CP3, la commande de procédure S-0-0128 (Contrôle de transition de CP4) doit être activée une nouvelle fois.

f) Si l’esclave ne détecte aucune erreur, il doit alors continuer le processus avec la ‘’Procédure sans erreur’’

- L'esclave doit acquitter la commande de procédure de manière positive (par exemple, "Commande de procédure exécutée correctement") et définir CPS prêt = 1.
- Après réception de l’acquittement positif de la commande de procédure, le maître doit supprimer la commande de procédure interne à l'esclave.
- Si le maître a saisi d’autres paramètres protégés en écriture en phase CP4, après l’acquittement positif de la commande de procédure, l’esclave doit alors définir CPS prêt = 0 et le maître doit répéter la commande de procédure S-0-0128 (Contrôle de transition de CP4) une nouvelle fois.
- Autrement, le maître peut alors déclencher une commutation sur CP4 (voir 5.2.3).

5.2.2.2.7 Phase de communication 4 (CP4)

La commutation sur CP4 correspond à la fin de l'initialisation.

En phase CP4, le maître peut autoriser tous les esclaves et l’application est prête à fonctionner. Le maître doit envoyer des MDT et AT configurés à tous les esclaves. L’échange de données valides en temps réel doit se faire par l’intermédiaire des connexions préparées définies pendant la phase CP4.

La fonction de connexion à chaud est activée dans le maître, lorsqu’elle est prise en charge.

La fiabilité de transmission pour la voie de service doit être garantie par la commande SVC, l’état SVC et la temporisation HS.

5.2.2.3 Transitions du diagramme d’états des CP

Le Tableau 53 décrit les transitions du diagramme d’états des CP.

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Tableau 53 – Transitions du diagramme d'états des CP

Transition		Condition	Description
Source	Cible		
état NRT	CP0	MST.Phase.CP=CP0	Le maître doit quitter l'état NRT pour CP0 sur demande de son utilisateur DL. Dans ce cas, le maître doit transmettre un MST avec CP0. Si l'esclave reçoit un MST (MDT0) avec CP0 pendant qu'il est à l'état NRT, l'esclave doit activer CP0 ainsi que le bouclage avec acheminement au port auquel ce même esclave a reçu le MST.
Ethertype = 0x88CD	état NRT	Pertes MST	En phase CP0, CP1 ou CP2: lorsqu'un esclave ne reçoit aucun MST lorsqu'il est en phase CP0, CP1 ou CP2 dans le délai de temporisation MST (130 ms), il doit alors commuter sur l'état NRT. En phase CP3 ou CP4: Si le nombre maximal de pertes MST (erreur de communication) dépasse S-0-1003 (Pertes MST admises en phases CP3&CP4), l'esclave doit alors commuter sur l'état NRT. Avant d'adopter l'état NRT à partir d'un état différent de CP0 ou HP0, l'esclave doit générer une liaison descendante sur les deux ports.
Ethertype = 0x88CD	état NRT	CPSwitch erroné	Si une erreur survient pendant la commutation de phase, alors: - l'esclave passe à l'état NRT. - le maître commute sur CP0 Pour une description détaillée, voir 5.2.3. Avant d'adopter l'état NRT à partir d'un état différent de CP0 ou HP0, l'esclave doit générer une liaison descendante sur les deux ports.
CP0	CP1	CPSwitch(CP1)	Dès que le maître a reçu au moins 100 AT0 avec le même contenu du compteur de séquences et dès que le nombre de champs d'index de topologie modifiés correspond au SEQCNT selon la topologie donnée et que tous les esclaves recommandés sont présents, le maître peut commencer à commuter sur CP1. L'attribution d'adresses doit être annulée dans l'esclave s'il reconnaît MST.Phase.CPS = 1.
CP1	CP2	CPSwitch(CP2)	Après l'initialisation de la voie de service de tous les esclaves sur le réseau de Type 19, le maître doit commuter sur CP2 (voir 5.2.3). SI le temps d'initialisation des voies de service est dépassé, le maître peut alors répondre avec un message d'erreur selon la configuration et commuter sur CP0.
CP2	CP3	CPSwitch(CP3)	La transition de CP2 à CP3 doit être effectuée seulement si les contrôles de S-0-0127 (contrôle de transition de CP3) ont été satisfaisants.
CP3	CP4	CPSwitch(CP4)	La transition de CP3 à CP4 doit être effectuée seulement si les contrôles de S-0-0128 (contrôle de transition de CP4) ont été satisfaisants.
CP1-CP4	CP0	CPSwitch(CP0)	Un retour à la phase CP0 doit être la seule possibilité de sortie des phases de communication CP1 à CP4 (autres que les phases de changement ascendantes). Une intervention de l'opérateur peut justifier ce retour. Tout esclave qui reconnaît la phase CP0 doit interrompre lui-même son fonctionnement de la meilleure façon possible. La méthode d'interruption de fonctionnement des esclaves fait partie intégrante des profils spécifiques à la fonction.

NOTE Les détails concernant le CPSwitch(CPx) sont décrits dans le diagramme d'états correspondant.

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5.2.3 Commutation des phases de communication (CPS)

5.2.3.1 Séquence de commutation CP dans le maître

La Figure 8 décrit le diagramme d’états CPS d’un maître. La configuration des DEL doit être ajustée sur l’état de topologie correspondant.

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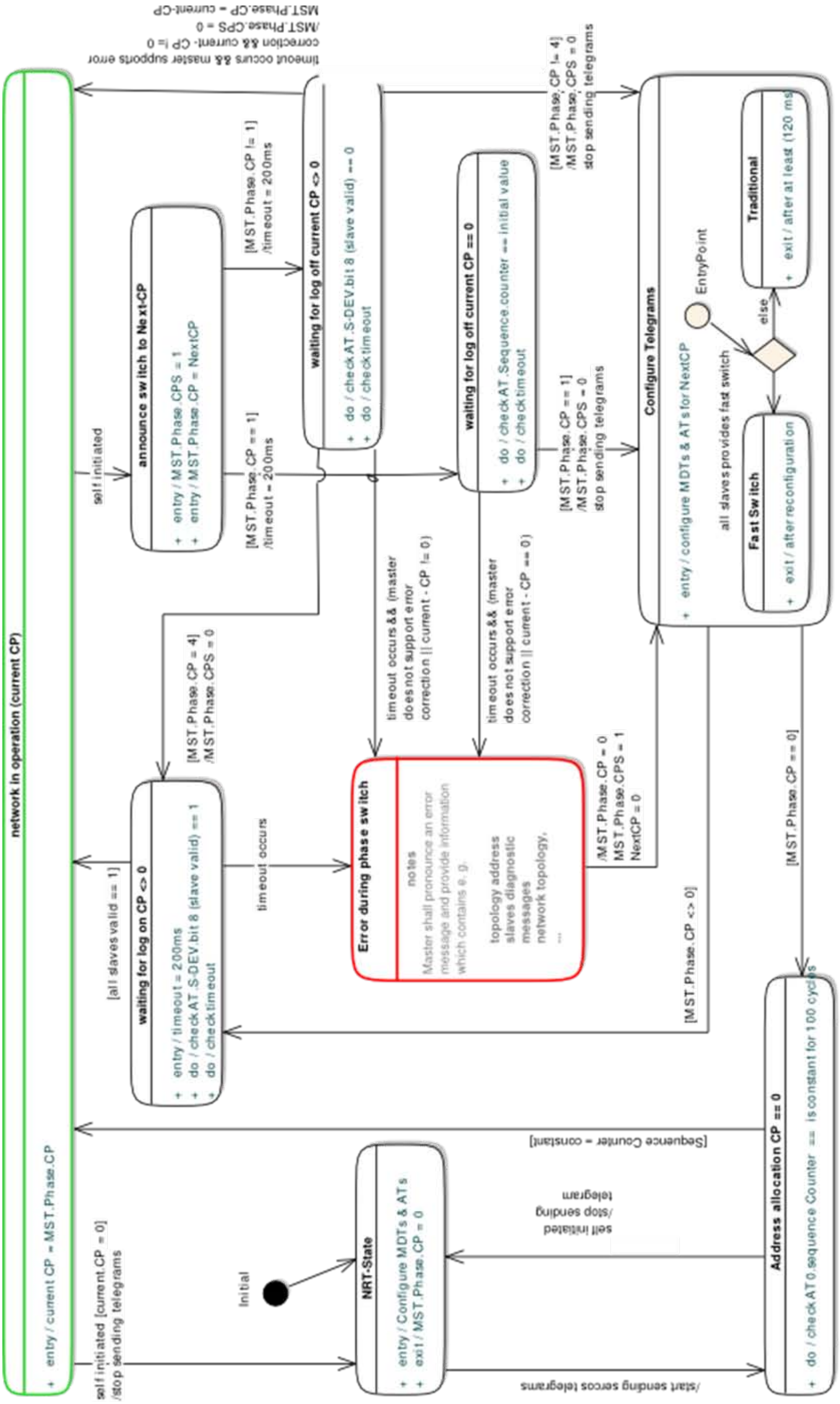

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Légende

Anglais	Français
Network in operation	Réseau en fonctionnement
(master)	(maître)
Self initiated	Auto-déclenché
Announce switch to Next – CP	Annonce de la commutation sur la CP suivante
Slave check ok	Contrôle esclave ok
Start sending telegrams	Début d'envoi de télégrammes
Timeout occurs	Temporisation active
master does not support error correction	Le maître ne prend pas en charge la correction d'erreur
Waiting for slave acknowledgment	Attente d'acquittement d'esclave
Waiting	Attente
Error during phase switch	Erreur au cours de la phase de commutation
Master shall pronounce an error telegrams and provide information which contains e.g. Topology address Slaves diagnostic telegrams Network topology	Le maître doit émettre un message d'erreur et fournir des informations contenant, par exemple L'adresse de topologie Les messages de diagnostic d'esclave La topologie du réseau
Stop sending telegrams	Arrêt d'envoi de télégrammes
Start sending sercos telegrams	Début d'envoi de télégrammes sercos
Configure telegrams	Configuration de télégrammes
All slaves valid	Tous les esclaves valides
Waiting for log on CP	Attente de connexion à CP
NRT state	Etat NRT
Waiting for log off current	Attente de déconnexion
Fast switch	Commutation rapide
Traditional	traditionnel

Figure 8 – Diagramme d'états CPSwitch du maître

NOTES

- CP actuelle = à la phase active dans le temps
- CP suivante = CP0 ou CP actuelle ou CP actuelle + 1 (seulement valide, si CP actuelle < 4)
- temporisation du maître CPS = 200 ms
- retard CPS = 120 ms
- SEQCNT = compteur de séquences dans l'AT0 de la phase CP0

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5.2.3.2 Etats du diagramme d’états CPSwitch du maître

Les états du diagramme d’états sont décrits dans le Tableau 54.

Tableau 54 – Etats du diagramme d'états CPSwitch du maître

État	Description
Etat NRT	A leur mise sous tension, le maître et chaque esclave doivent activer l’état NRT de manière indépendante. Le mode NRT est activé pendant l’état NRT. La mémoire tampon de collision doit être administrée tel qu’il est décrit dans le diagramme d’états de topologie. Le maître doit quitter l’état NRT pour CP0 sur demande de son utilisateur DL. L’esclave doit vérifier le MST des télégrammes de Type 19. Lorsque l’esclave reconnaît un • MST avec CP = 0, il doit alors activer CP0 et modifier la topologie (voir 5.3.6). • MST avec CP = 4, il doit alors activer HP0, si la connexion à chaud est prise en charge. Avant d’adopter l’état NRT à partir d’un état différent de CP0 ou HP0, l’esclave doit générer une liaison descendante sur les deux ports. Dans l’état NRT, l’esclave peut activer la configuration #1 des DEL de Type 19.
Attribution d’adresses CP == 0	Le maître doit régler la temporisation de maître CPS (200 ms) et attend jusqu’à ce que le SEQCNT reçu de l’AT0 soit constant. Le maître doit vérifier le compteur de séquences (SEQCNT) reçu de l’AT0. Si le compteur de séquences n’est pas modifié au cours de 100 cycles de communication successifs, le maître peut alors commuter sur l’état ‘’ réseau en fonctionnement’’.
Attente de connexion CP ≠ 0	Le maître doit régler la temporisation de maître CPS (200 ms) et attend jusqu’à ce que tous les bits valides des esclaves soient réglés sur 1. Dans les phases CP1 à CP4, le maître doit vérifier le bit valide des esclaves. Si le bit valide des esclaves est réglé sur 1 par chaque esclave, le maître commute alors sur l’état ‘’réseau en fonctionnement’’.
Réseau en fonctionnement (CP actuelle)	Le maître transmet les MDT et AT avec la synchronisation de la phase CP actuelle.
Annonce de la commutation sur la CP suivante	Pour pouvoir commuter la phase de communication, le maître doit définir les conditions de MST (CPS = 1 et CP suivante). Le maître doit déterminer la CP suivante; voir notes.
Attente de déconnexion CP actuelle == 0	Le maître doit régler la temporisation de maître CPS (200 ms) et attend jusqu’à ce que le SEQCNT reçu soit égal au SEQCNT transmis (valeur initiale du SEQCNT transmis =1). En phase CP0 (MST.Phase.CPS = 1 && MST.Phase.CP = 1), le maître doit vérifier le compteur de séquences reçu de l’AT0. Si le compteur de séquences n’est pas modifié par un esclave quelconque, le maître commute alors sur l’état ‘’Configuration de télégrammes’’.
Attente de déconnexion CP actuelle ≠ 0	Le maître doit régler la temporisation de maître CPS (200 ms) et reste en attente tant que les esclaves ne règlent pas le bit valide des esclaves sur 1. Aussi longtemps qu’un esclave règle le bit valide des esclaves sur 1, le maître conserve cet état et doit transmettre les MDT et les AT. Dans les phases CP1 à CP4 (MST.Phase.CP ≠ 1 && MST.Phase.CPS = 1), le maître doit vérifier le bit valide des esclaves. Si le bit valide des esclaves est réglé sur 0 par chaque esclave, le maître commute alors sur l’état ‘’Configuration de télégrammes’’.
Configuration de télégrammes	Le maître doit arrêter la transmission des MDT et AT. Le maître doit configurer les télégrammes MDT, AT et la synchronisation pour la phase CP suivante. Si tous les esclaves sur le réseau prennent en charge la commutation du CPS sans le retard CPS, le maître active alors l’état ‘’ Commutation rapide’’. Autrement, le maître doit activer l’état ‘’traditionnel’’.
Commutation rapide	Le maître commute immédiatement sur l’état annoncé (Temps de retard CPS = 0ms).
Traditionnel	Le maître attend l’écoulement du retard CPS (120 ms), puis commute sur l’état annoncé.
Erreur lors de la commutation de phase	Le maître doit générer un message d'erreur contenant, par exemple, • une adresse d’appareil

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État	Description
	• un index de topologie • un diagnostic d'esclave • un diagnostic de réseau et • des commutations sur CP0.

5.2.3.3 Transitions du diagramme d'états CPSwitch du maître

Les transitions du diagramme d'états sont décrites dans le Tableau 55.

Tableau 55 – Transitions du diagramme d'états CPSwitch du maître

Transition			Description
Source	**Cible**	**Condition**	
État NRT	Attribution d'adresses CP == 0	Début d'envoi de télégrammes de Type 19	Le maître quitte l'état NRT et commute sur CP0 avec l'envoi de MST avec CP0.
Réseau en fonctionnement	État NRT	CP actuelle = 0 auto-déclenchée Arrêt d'envoi de télégrammes	Le maître ne doit commuter de CP0 sur l'état NRT que lorsqu'il ne transmet plus de télégrammes de Type 19.
Attribution d'adresses CP == 0	Réseau en fonctionnement	SEQCNT = constant	Si le compteur de séquences est constant pendant 100 cycles, la CP suivante (CP1) peut alors être activée par le maître et l'attribution d'adresses prend fin.
Attribution d'adresses CP == 0	État NRT	Arrêt d'envoi de télégrammes auto-déclenché	Si le maître ne reconnaît pas un SEQCNT constant au cours de 100 cycles, la vérification est alors répétée jusqu'à dix fois. Si aucun résultat constant n'est obtenu au cours de cet intervalle, le maître génère alors un message d'erreur et passe à l'état NRT.
Réseau en fonctionnement	Annonce de la commutation sur la CP suivante	Auto-déclenché	Si le maître souhaite modifier la phase de communication, il active alors l'état "Annonce de la commutation sur la CP suivante". Le maître doit régler CPS = 1 et MST.Phase.CP sur la CP suivante (voir notes).
Annonce de la commutation sur la CP suivante	Attente de déconnexion, CP actuelle = 0	MST.Phase.CP = 1 Temporisation de maître CPS = 200 ms	Après que le maître a annoncé la CP suivante avec CP1, il règle la temporisation de maître CPS et déclenche l'état " Attente de déconnexion, CP actuelle = 0".
Annonce de la commutation sur la CP suivante	Attente de déconnexion, CP actuelle ≠ 0	MST.Phase.CP ≠ 1 Temporisation de maître CPS = 200ms	Après que le maître a annoncé la CP suivante avec CP ≠ 1, il règle la temporisation de maître CPS et déclenche l'état " Attente de déconnexion, CP actuelle ≠ 0''
Attente de déconnexion, CP actuelle = 0	Configuration de télégrammes	MST.Phase.CP = 1, CPS = 0 Arrêt d'envoi de télégrammes	Si le compteur de séquences n'est pas modifié par tout esclave en phase CP0, le maître arrête la transmission des MDT et AT, déclenche l'état "Configuration de télégrammes" et prépare la CP suivante.
Attente de déconnexion, CP actuelle ≠ 0	Configuration de télégrammes	MST.Phase.CP ≠ 4, CPS = 0 Arrêt d'envoi de télégrammes	Si esclave valide = 0 de tous les esclaves dans les phases CP1 à CP3, le maître arrête la transmission des MDT et AT, déclenche l'état "Configuration de télégrammes" et prépare la CP suivante.
Attente de déconnexion, CP actuelle ≠ 0	Attente de connexion, CP ≠ 0	MST.Phase.CP = 4, CPS = 0	S'il commute de la phase CP3 à la phase CP4, le maître n'interrompt pas la transmission des MDT et AT, dans la mesure où la structure des télégrammes de Type 19 et la synchronisation sont identiques.

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Transition			Description
Source	Cible	Condition	
Configuration de télégrammes	Attente de connexion, CP actuelle ≠ 0	MST.Phase.CP ≠ 0	Après la configuration des télégrammes de Type 19 pour la CP suivante (CP1 à CP3) et l'occurrence du retard CPS, le maître doit transmettre les télégrammes de Type 19 avec la structure et la synchronisation de la CP suivante.
Configuration de télégrammes	Attribution d'adresses CP = 0	MST.Phase.CP = 0	Après la configuration des télégrammes de Type 19 pour la CP0 et l'occurrence du retard CPS, le maître doit transmettre les télégrammes de Type 19 avec la structure et la synchronisation de la CP0.
Attente de connexion, CP actuelle ≠ 0	Réseau en fonctionnement	esclave valide = 1 de tous les esclaves	Si esclave valide = 1 de tous les esclaves, la CP suivante (CP0, CP2 à CP4) peut alors être activée par le maître.
Attente de déconnexion, CP actuelle ≠ 0	Réseau en fonctionnement	Occurrence de temporisation de maître CPS et prise en charge de la correction d'erreur par le maître	Si la CP actuelle ≠ 0, le maître active une nouvelle fois la CP actuelle en réglant la MST.Phase.CP = CP actuelle et CPS = 0. A présent, le maître peut vérifier la raison de la déconnexion d'un ou de plusieurs esclaves. Si la cause de l'erreur peut être redressée, la commutation de phase doit se poursuivre. Si l'erreur ne peut être corrigée, le maître doit commuter sur CP0.
Erreur lors de la commutation de phase			
Attente de connexion, CP ≠ 0	Erreur lors de la commutation de phase	Occurrence de temporisation de maître CPS	Lorsque le maître n'a pas reçu Esclave valide = 1 de chaque esclave après dépassement de la temporisation de maître CPS dans les phases CP1 à CP4, le maître doit alors générer un message d'erreur qui indique, par exemple, les adresses d'appareil et les index de topologie respectifs**.** Après suppression de l'erreur par l'unité de commande, le maître doit commuter sur CP0.
Attente de déconnexion, CP actuelle = 0	Erreur lors de la commutation de phase	Occurrence de temporisation de maître CPS et absence de prise en charge de la correction d'erreur par le maître	Lorsque le maître continue à recevoir un SEQCNT modifié de l'AT0 après dépassement de la temporisation de maître CPS en phase CP0, le maître doit alors générer un message d'erreur qui indique, par exemple, les adresses d'appareil et les index de topologie respectifs. Après suppression de l'erreur par l'unité de commande, le maître doit commuter sur CP0.
Attente de déconnexion, CP actuelle ≠ 0	Erreur lors de la commutation de phase	Occurrence de temporisation de maître CPS et absence de prise en charge de la correction d'erreur par le maître	Lorsque le maître continue à recevoir Esclave valide = 1 d'un ou de plusieurs esclaves après dépassement de la temporisation de maître CPS dans les phases CP1 à CP4, le maître doit alors générer un message d'erreur qui indique, par exemple, les adresses d'appareil et les index de topologie respectifs. Après suppression de l'erreur par l'unité de commande, le maître doit commuter sur CP0.
Erreur lors de la commutation de phase	Configuration de télégrammes	CP suivante = 0	Le maître quitte l'état "erreur" en définissant MST.Phase.CP = 0 et MST.Phase.CPS = 1. Le maître commute sur la phase CP0 via l'état ‘' configuration de télégrammes''

5.2.3.4 Séquence de commutation CP dans l'esclave

La Figure 9 présente le diagramme d'états CPSwitch de l'esclave.

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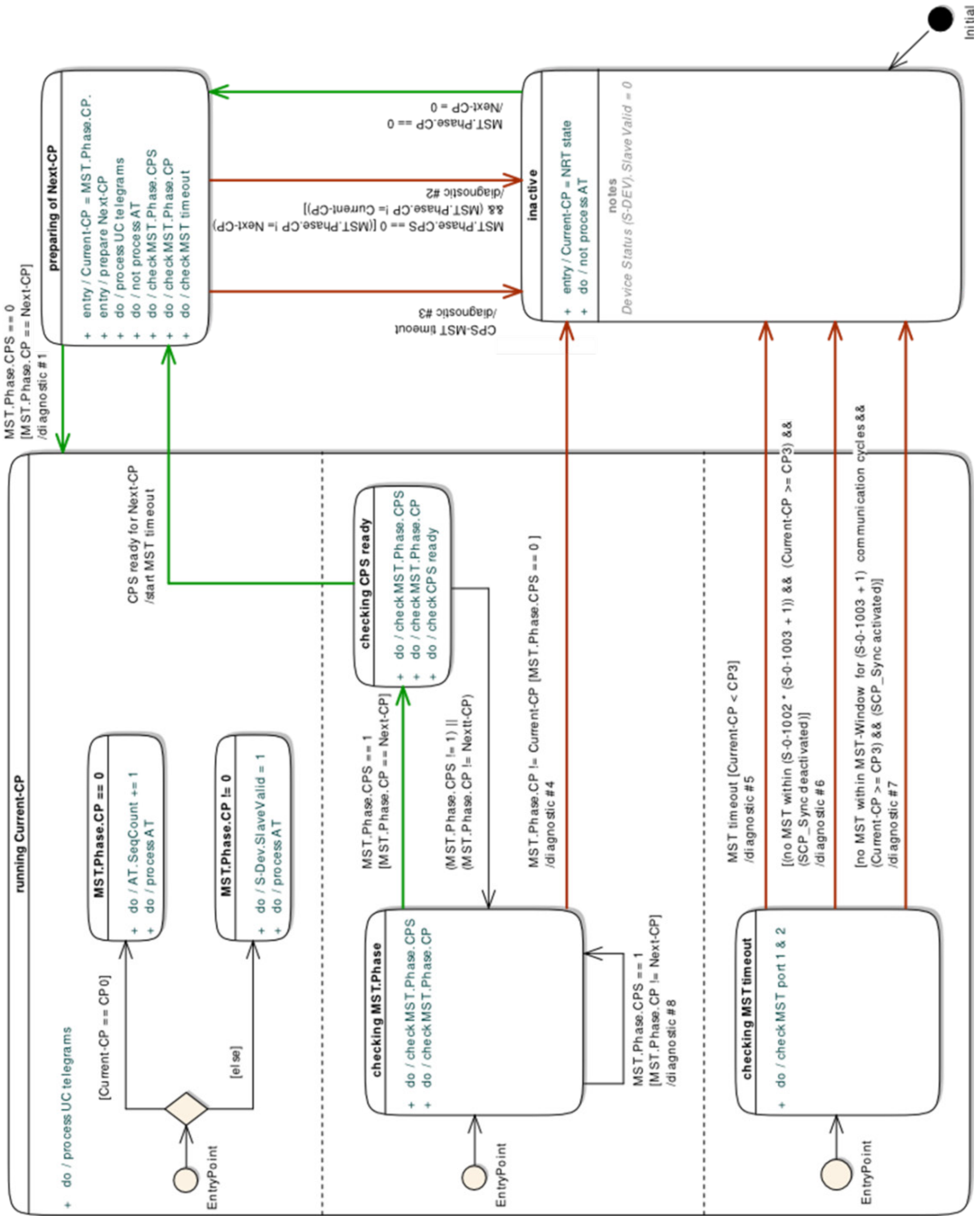

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Légende

Anglais	Français
Running current CP	CP actuelle en fonctionnement
Do not process AT	Ne pas traiter AT
(slave ready for NextCP)	(esclave prêt pour NextCP)
Inactive	Inactif
Preparing of next CP	Préparation CP suivante
Checking MST.Phase	Vérification MST.Phase
Checking CPS ready	Vérification CPS prêt
Checking MST timeout	Vérification temporisation MST

Figure 9 – Diagramme d'états CPSwitch de l'esclave

NOTES

- CP actuelle = à la phase active dans le temps
- CP suivante = CP0 ou CP actuelle ou CP actuelle + 1 (seulement valide, si CP actuelle < 4)
- SEQCNT = compteur de séquences dans l'AT0 de la phase CP0
- temporisation MST CPS = 500 ms
- temporisation MST = 130 ms

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5.2.3.5 Etats de commutation CP dans l'esclave

Le Tableau 56 présente les états du diagramme d'états CPSwitch de l'esclave.

Tableau 56 – Etats du diagramme d'états CPSwitch de l'esclave

État	Description
CP actuelle en fonctionnement	Cet état contient les états suivants qui sont traités simultanément: • MST.Phase.CP == 0 • MST.Phase.CP != 0 • vérification MST.Phase • vérification temporisation MST • vérification CPS prêt L'esclave doit traiter les télégrammes UCC.
MST.Phase.CP == 0	L'esclave active CP0 et doit évaluer la Version de communication dans le MDT0 de la CP0 et doit activer l'Attribution d'adresses.
MST.Phase.CP != 0	En fonction de la CP actuelle, l'esclave active les phases CP1, CP2, CP3 ou CP4. L'esclave doit régler S-DEV.SlaveValid sur 1 et doit traiter les MDS et AS comme défini dans la CP correspondante.
vérification MST.Phase	L'esclave doit reconnaître la commutation de phase dans le MST avec CPS = 1 et CP suivante. La CP suivante doit être est égale à la • CP actuelle +1 (valide, seulement si CP actuelle < 4) ou • CP0
vérification temporisation MST	L'esclave doit vérifier le MST sur les deux ports relatifs à la CP.
vérification CPS prêt	Si l'esclave reconnaît les conditions suivantes • MST.Phase.CPS est égal à 1 et • MST.Phase.CP est égal à la CP suivante et la • Commande de procédure relative à la CP s'est achevée positivement (CP2 et CP3 uniquement) et • SVC valide est égal à 1, l'esclave génère alors "CPS prêt pour CP actuelle" en réglant ''Esclave valide'' sur 0
préparation CP suivante	L'esclave ne doit plus saisir de données dans les AT. L'esclave saisit MST.Phase.CP dans la CP actuelle. L'esclave prépare en interne la CP suivante et active la temporisation MST CPS. Ce chien de garde est déclenché avec chaque MST reçu. L'esclave attend que MST avec MST.Phase.CPS soit 0 et MST.Phase.CP soit la CP suivante. L'esclave doit traiter les télégrammes UCC.
Inactif	L'esclave doit définir "Esclave valide = 0" et ne doit plus saisir de données dans les AT. L'esclave doit activer l'état NRT et doit traiter les télégrammes UCC. Avant d'adopter l'état NRT à partir d'un état différent de CP0 ou de HP0, l'esclave doit générer une liaison descendante sur les deux ports.

5.2.3.6 Transitions de commutation CP dans l'esclave

Les transitions du diagramme d'états sont présentées dans le Tableau 57, le Tableau 58 et le Tableau 59.

Tableau 57 – Transitions du diagramme d'états CPSwitch de l'esclave

Transition avec avertissement			Description
Source	Cible	Condition	
Inactif	préparation de la	MST.Phase.CP == 0	CP suivante = 0, l'esclave commute sur CP0.

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Transition avec avertissement			Description
Source	Cible	Condition	
	CP suivante		
préparation de la CP suivante	CP actuelle en fonctionnement	MST.Phase.CPS == 0 && MST.Phase.CP == CP suivante	Le maître a achevé correctement la commutation de phase. L'esclave génère le diagnostic #1 et déclenche l'état "CP actuelle en fonctionnement".
CP actuelle en fonctionnement	MST.Phase.CP == 0	CP actuelle == 0	L'esclave commute sur CP0.
CP actuelle en fonctionnement	MST.Phase.CP != 0	CP actuelle != 0	En fonction de la CP actuelle, l'esclave commute sur CP1, CP2, CP3 ou CP4.
vérification MST.Phase	vérification CPS prêt	MST.Phase.CPS == 1 && MST.Phase.CP == CP suivante	Le maître annonce correctement la CP suivante avec CPS = 1. L'esclave déclenche l'état "Vérification CPS prêt''
vérification CPS prêt	vérification MST.Phase	MST.Phase.CPS != 0 ou MST.Phase.CP != CP suivante	Si l'esclave détecte un changement dans MST.Phase.CPS ou dans MST.Phase.CP, il doit alors revenir à l'état ''vérification MST.Phase''. **Recommandation:** Il convient que le maître renvoie l'esclave avec la condition MST.Phase.CPS = 0 && MST.Phase.CP = CP actuelle, en vue de ne pas générer des erreurs. Le maître peut vérifier le diagnostic de l'esclave pour voir la raison pour laquelle il n'a pas défini le CPS prêt pour la CP suivante.
vérification CPS prêt	préparation de la CP suivante	CPS prêt pour CP suivante	Si l'esclave détermine CPS prêt pour la CP suivante, il doit alors régler l'Esclave valide sur 0 et activer l'état ''préparation de la CP suivante''.

Tableau 58 – Transitions du diagramme d'états CPSwitch de l'esclave (transitions avec avertissement)

Transition avec avertissement			Description
Source	Cible	Condition	
vérification MST.Phase	vérification MST.Phase	MST.Phase.CPS == 1 && MST.Phase.CP != CP suivante	Le maître annonce de manière incorrecte la CP suivante avec CPS = 1, ce qui signifie que la CP suivante n'est pas la CP actuelle ou CP actuelle+1 (valide seulement si CP actuelle < 4) ou CP0. Dans ce cas, l'esclave génère le diagnostic #8 et conserve le même état.

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Tableau 59 – Transitions du diagramme d'états CPSwitch de l'esclave (transitions avec erreur)

Transition avec erreur			Description
Source	**Cible**	**Condition**	
vérification MST.Phase	Inactif	MST.Phase.CPS == 0 && MST.Phase.CP != CP actuelle	Le maître modifie la phase sans CPS = 1. L'esclave génère le diagnostic #4 et déclenche l'état "inactif".
vérification temporisation MST	Inactif	Temporisation MST && CP actuelle < CP3	Temporisation MST dans les phases CP0 à CP2: L'esclave ne reçoit pas de MST dans la temporisation MST (130 ms). Il génère le diagnostic #5 et déclenche l'état "inactif".
vérification temporisation MST	Inactif	Pas de MST dans (S-0-1002 * (S-0-1003 + 1)) && (CP actuelle ≥ CP3) && (SCP_Sync désactivé)	Pertes MST en CP3 et CP4 sans SCP_Sync: L'esclave sans SCP_Sync ne reçoit aucun MST dans le délai MST défini par S-0-1002 (Durée de cycle de communication (tScyc)) et S-0-1003 (Pertes MST admises) en CP3&CP4. Temporisation MST = tScyc * (pertes MST admises + 1). L'esclave génère le diagnostic #6 et déclenche l'état "inactif".
vérification temporisation MST	Inactif	(pas de MST dans la fenêtre MST) pour (S-0-1003 + 1) cycles de communication && (CP actuelle ≥ CP3) && (SCP_Sync activé)	Pertes MST en CP3 et CP4 avec SCP_Sync: L'esclave avec SCP_Sync reconnaît plus de pertes MST successives que ce qui est défini par S-0-1003 (Pertes MST admises) en CP3&CP4 (pertes MST admises + 1). L'esclave génère le diagnostic #7 et déclenche l'état "inactif".
préparation CP suivante	Inactif	Temporisation MST-CPS (500 ms)	Si la temporisation MST-CPS se produit, l'esclave génère alors le diagnostic #3 et déclenche l'état « inactif».
préparation CP suivante	Inactif	MST.Phase.CPS == 0 && (MST.Phase.CP != CP suivante) && (MST.Phase.CP != CP actuelle)	Au cours de la commutation de phase, le maître modifie la phase en phase CP non valide. L'esclave génère le diagnostic #2 et déclenche l'état "inactif".

5.2.3.7 Diagnostic du diagramme d'états CPS

Au cours des transitions CPS, l'esclave génère le diagnostic présenté dans le Tableau 60.

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Tableau 60 – Diagnostic de l'esclave de diagramme d'états CPS

Diagnostic	Etat d'appareil	Configuration de DEL	S-0-0390	S-0-0014	Description
#1	Bit 7 = 0 Bit 6 = 0	MST.Phase.CP	—	Bit 2..0 = MST.Phase .CP	Commutation de la phase de communication achevé sans erreur
#2 (A utiliser dans les nouvelles implémentations des appareils de Type 19)	Bit 7 = 1	Erreur de communication	0xC30F4019	Bit 13 = 1	Alors que la commutation de phase est actif, le maître définit MST.Phase.CPS = 0 et MST.Phase.CP selon l'une des conditions non valides suivantes: • MST.Phase.CPS >4, CP invalide. • MST.Phase.CP ≠ CP actuelle + 1, séquence invalide lors du changement de phase ascendant. • MST.Phase.CP ≠ CP0, séquence invalide lors du changement de phase descendant.
#2a (utilisé jusqu'à V1.1.2 de CP16/3)	Bit 7 = 1	Erreur de communication	0xC30F4003	Bit 5 = 1	Lors de la commutation de phase, le maître définit MST.Phase.CPS = 0 et MST.Phase.CPS >4, CP invalide.
#2b (utilisé jusqu'à V1.1.2 de CP16/3)	Bit 7 = 1	Erreur de communication	0xC30F4004	Bit 6 = 1	Lors de la commutation de phase, le maître définit MST.Phase.CPS = 0 et MST.Phase.CP ≠ CP actuelle + 1, séquence invalide lors du changement de phase ascendant.
#2c (utilisé jusqu'à V1.1.2 de CP16/3)	Bit 7 = 1	Erreur de communication	0xC30F4005	Bit 7 = 1	Lors de la commutation de phase, le maître définit MST.Phase.CPS = 0 et MST.Phase.CP ≠ CP0, séquence invalide lors du changement de phase descendant.
#3	Bit 7 = 1	Erreur de communication	0xC30F4017	Bit 12 = 1	Alors que la commutation de phase est active, le maître ne renvoie pas de MST et la temporisation MST-CPS se produit dans l'esclave.
#4 (A utiliser dans les nouvelles implémentations des appareils de Type 19)	Bit 7 = 1	Erreur de communication	0xC30F4019	Bit 13 = 1	Le maître modifie la MST.Phase.CP avec MST.Phase CPS = 0 et MST.Phase.CP est définie selon l'une des conditions non valides suivantes: • MST.Phase.CP > 4, CP invalide. • MST.Phase.CP ≠ CP actuelle + 1, séquence invalide lors du changement de phase ascendant. • MST.Phase.CP ≠ CP0, séquence invalide lors du changement de phase descendant.
#4a (utilisé jusqu'à V1.1.2 de CP16/3)	Bit 7 = 1	Erreur de communication	0xC30F4003	Bit 5 = 1	Le maître modifie la CP avec MST.Phase.CPS = 0 et définit MST.Phase.CP > 4, --> CP invalide.
#4b ((utilisé jusqu'à V1.1.2 de CP16/3)	Bit 7 = 1	Erreur de communication	0xC30F4004	Bit 6 = 1	Le maître modifie la CP avec MST.Phase.CPS = 0 et définit MST.Phase.CP ≠ CP actuelle + 1, séquence invalide lors du changement de phase ascendant.
#4c	Bit 7 = 1	Erreur de	0xC30F4005	Bit 7 = 1	Le maître modifie la CP avec

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Diagnostic	Etat d'appareil	Configuration de DEL	S-0-0390	S-0-0014	Description
(utilisé jusqu'à V1.1.2 de CP16/3)		communication			MST.Phase.CPS = 0 et définit MST.Phase.CP ≠ CP0, séquence invalide lors du changement de phase descendant.
#4d ((utilisé jusqu'à V1.1.2 de CP16/3)	Bit 7 = 1	Erreur de communication	0xC30F4006	--	Le maître modifie la CP actuelle avec MST.Phase.CPS = 0.
#6	Bit 7 = 1	Erreur de communication	0xC30F4001	Bit 3 = 1	En CP3 et CP4, l'esclave n'a pas reçu de MST dans le délai défini par S-0-1002 (Durée de cycle de communication) (tScyc) et S-0-1003 (Pertes de données admises en CP3&CP4, [S-0-1002 * (S-0-1003 + 1)], SCP_Sync est désactivé.
#7	Bit 7 = 1	Erreur de communication	0xC30F4001	Bit 3 = 1	En CP3 et CP4, le nombre des pertes MST successives dépasse la valeur définie dans S-0-1003 (Pertes de MST admises) en CP3&CP4. SCP_Sync est activé.
#8	Bit 6 = 1	---	0xC30E4019	Bit 2..0 = CP actuelle	Le maître modifie la MST.Phase.CP avec CPS = 1 et MST.Phase.CP est définie selon l'une des conditions non valides suivantes • MST.Phase.CPS >4, CP invalide • MST.Phase.CP ≠ CP actuelle + 1, séquence invalide lors du changement de phase ascendant. • MST.Phase.CP ≠ CP0, séquence invalide lors du changement de phase descendant.
#5	---	Etat NRT	0xC30A0008	Bit 2..0 = 7 (-1)	La temporisation MST (130 ms) se produit dans les phases CP0 à CP2, l'esclave doit commuter l'état NRT

5.2.4 Version de communication

Le maître transmet la version de communication dans le MDT0 de la phase CP0. La version de communication (voir Tableau 9) définit les fonctions utilisées par le maître dans les phases CP1 et CP2.

- L'esclave doit comparer la version de communication reçue avec sa propre version.
- Si l'esclave ne détecte aucune différence, il doit alors participer à la phase CP0 et se conformer aux exigences du maître.
- Si l'esclave détecte une différence, il doit alors vérifier en premier lieu ‘'la structure de base de l'AT0 (bits-7-0) et en second lieu les fonctions requises et les fonctions supplémentaires de CP0 à CP2 (bits 31-8), tel que décrit ci-dessous.

a) Bits 7-0 de la Version de communication

1) Si l'esclave ne détecte aucune différence dans les bits 7-0, il doit alors participer à la phase CP0 et se conformer aux exigences du maître.

2) Si l'esclave détecte une différence dans les bits 7-0, il ne connaît pas alors la structure de l'AT0 et peut ne pas communiquer avec le maître.

   - L'esclave ne doit pas participer à la transmission de Type 19 en phase CP0, cela signifie qu'il ne doit pas intégrer des données (par exemple, son adresse d'appareil) dans l'AT0.

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- L’esclave peut indiquer cela sur sa DEL de Type 19 (configuration #13). Dans ce cas, le changement de phase ascendant vers la CP0 n’est pas possible.
- Continuité avec la Réaction d’erreur

b) Bits 31-8 de la Version de communication

1) Toutes les fonctions supplémentaires doivent être prises en charge par l’esclave.
2) Si l’esclave prend en charge toutes les fonctions requises, l’esclave doit alors définir ‘’bit 15= 1’’ dans l’index de topologie de l’AT0 de la phase CP0.
3) Si l’esclave ne prend pas en charge toutes les fonctions requises, l’esclave
   - peut indiquer cela sur sa DEL de Type 19 (configuration #13),
   - doit traiter l’attribution d’adresses dans l’AT0 de la phase CP0 et
   - doit définir bit = 0 de l’index de topologie dans l’AT0 de la phase CP0.
   - Dans ce cas, le changement de phase ascendant vers la CP1 n’est pas possible.

c) Réaction d’erreur

1) Si le maître commute avec la version de communication annoncée sur CP1, l’esclave doit alors régler le numéro de diagnostic (ou S-0-0390) sur 0xC30F4021 et activer l’état NRT.
   - Le maître peut identifier l’erreur et génère un message d'erreur qui apparaît sur l’écran d’affichage.
   - Dans ce cas, le maître doit activer une nouvelle fois la phase CP0 et doit annoncer une version de communication antérieure, qui est prise en charge par tous les esclaves. Sinon, le changement de phase n’est pas possible.

5.2.5 Attribution d'adresses dans le maître et l'esclave

Le maître et l’esclave doivent toujours prendre en charge l’attribution des adresses.

L’adresse de topologie déterminée par l’attribution d’adresses est utilisée pour l’adressage de la voie de service des phases CP1 et CP2. Une adresse de sous-appareil valide n’est par conséquent pas nécessaire dans les phases CP0 à CP2.

Le contenu de l'index de topologie dans l’AT0 de la phase CP0 doit être comme cela est spécifié dans le Tableau 28.

Fonction avec ligne, anneau et anneau interrompu:

- Le maître doit transmettre l'AT0 et régler le contenu comme cela est spécifié dans le Tableau 27.
- L'esclave doit lire et incrémenter le contenu du champ de compteur de séquences (SEQCNT) dans le télégramme AT0. Le compteur de séquences en lecture correspond à l’ordre de l’esclave dans la topologie, appelé adresse de topologie (TADR).
- Par ailleurs, l’esclave doit saisir son adresse de sous-appareil dans le champ d’index de topologie correspondant. Les esclaves avec l’adresse de sous-appareil = 0 ou > 511 doivent prendre en charge la phase CP0 de la même manière que les esclaves avec l’adresse de sous-appareil 1 à 511.
- L’attribution d’adresses doit être effectuée par l’esclave en phase CP0 à chaque télégramme AT0 transmis.
- Les appareils à esclaves multiples incrémentent le comptage de séquences par palier de un pour chaque esclave
- Chaque esclave reçoit deux compteurs de séquences (port 1 et port 2), et le compteur de séquences supérieur est rejeté.
- L'esclave masque toujours le bit 15 du compteur de séquences valide lorsqu'il détermine sa propre adresse de topologie.

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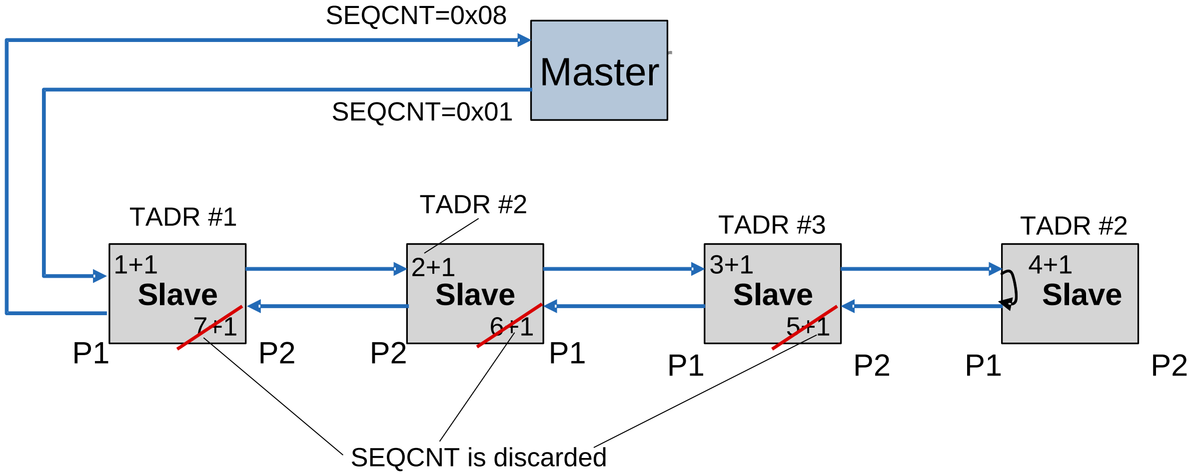
Fonction supplémentaire avec ligne uniquement (voir Figure 10):

- Le dernier esclave de la ligne incrémente le compteur de séquences une seule fois.
- Le maître masque toujours le bit 15 du compteur de séquences reçu.
- Pour la surveillance, le maître doit diviser le compteur de séquences par 2 afin d'obtenir le nombre d'esclaves dans la topologie.



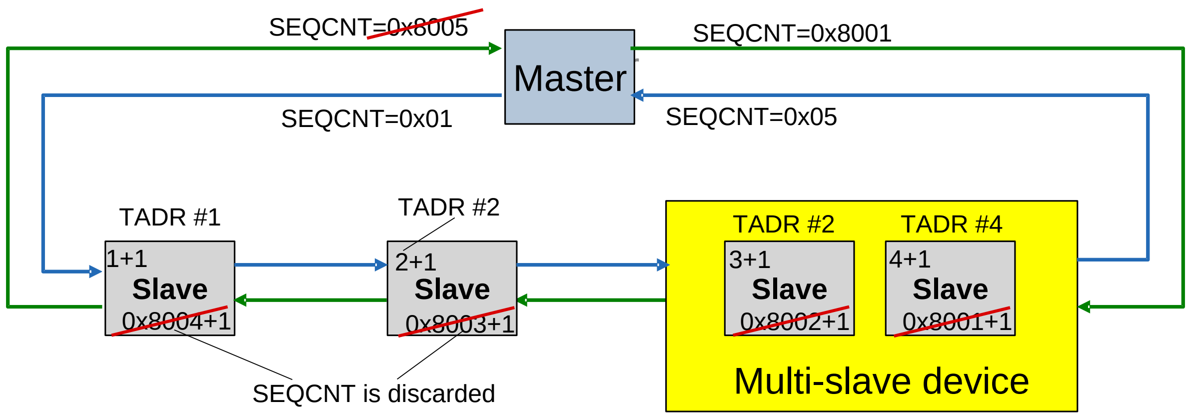
Légende

Anglais	Français
Master	Maître
Slave	Esclave
SEQCNT is discarded	SEQCNT est rejeté

Figure 10 – Attribution d'adresses avec ligne

Fonction supplémentaire avec anneau uniquement (voir Figure 11):

- Le maître reçoit deux compteurs de séquences (port 1 et port 2), et le compteur de séquences supérieur est rejeté.
- Pour la surveillance, le maître doit décrémenter le compteur de séquences de 1 afin d'obtenir le nombre d'esclaves dans la topologie.



Légende

Anglais	Français
Master	Maître
Slave	Esclave

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Anglais	Français
SEQCNT is discarded	SEQCNT est rejeté
Multi-slave device	Appareil à esclaves multiples

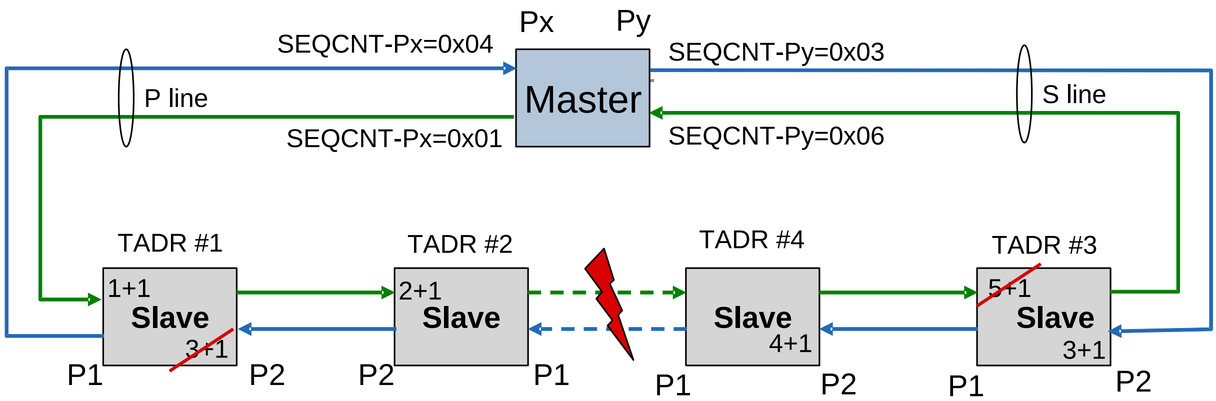
Figure 11– Attribution d'adresses avec anneau

Fonction supplémentaire avec anneau interrompu uniquement (voir Figure 12):

- Le dernier esclave de la ligne incrémente le compteur de séquences une seule fois.
- Le maître doit transmettre le compteur de séquences avec la valeur 0x01 sur le port x. Le compteur de séquences reçu sur le port Px doit être modifié et transmis sur le port Py.
- Modification du compteur de séquences sur le port Py:

$$SEQCNT\_Py = \frac{SEQCNTreçu\_Px}{2} + 0x8001$$

- Le maître doit transmettre le compteur de séquences modifié sur le Port Py. Il est nécessaire d'obtenir une adresse de topologie unique, dans la mesure où les voies de service sont traitées par l'adresse de topologie des phases CP1 et CP2.
- Le maître masque toujours le bit 15 des deux compteurs de séquences reçus.
- Le maître doit établir la liste des adresses d'appareil de la ligne avec le SEQCNT supérieur reçu en ordre inversé dans sa table d'adresses (par exemple, à des fins de diagnostic avec une adresse d'appareil et un index de topologie).
- Lorsque le maître détecte que l'anneau peut être fermé, il peut alors fermer l'anneau dans les phases CP1 à CP4.



Légende

Anglais	Français
Master	Maître
Slave	Esclave
P line	Ligne P
S line	Ligne S

Figure 12 – Attribution d'adresses avec anneau interrompu

Le maître doit attendre de recevoir ses MDT0 et AT0. Selon sa configuration, le maître peut comparer les adresses d'appareil détectées avec les adresses d'appareil qu'il est supposé trouver, puis évaluer les écarts (par exemple, générer un message d'erreur).

Si la procédure d'attribution d'adresses ne peut être réalisée dans le délai défini par le maître, ce dernier doit rester en phase CP0 et générer un message. L'objet du message et le point au niveau duquel il est à activer sont fonction du maître.

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Le maître peut générer les 4 diagnostics suivants en phase CP0:

- adresse d’appareil erronée: adresse d’appareil = 0 ou supérieure à 511.
- adresse d’appareil identique: le maître a trouvé plusieurs adresses d’appareil ayant la même valeur.
- adresse d’appareil non prise en charge: l’adresse d’appareil n’est pas prise en charge par le maître.
- adresse d’appareil inutile (esclave perdu): adresse d’appareil non nécessaire pour l’application.

5.3 Topologies de réseau

5.3.1 Introduction

La topologie de réseau physique se compose de lignes de transmission point à point bidirectionnelles simultanées et de participants. Le maître et les esclaves font partie du réseau de Type 19 et constituent ses participants.

Chaque esclave a deux ports de communication (port 1 et port 2). Le port 1 (P1) et le port 2 (P2) doivent être interchangeables.

La topologie de réseau physique doit être une structure en anneau ou une structure linéaire. Un anneau doit comporter deux canaux logiques (principal et secondaire) et une ligne doit comporter uniquement un canal logique (principal ou secondaire).

La différence entre la structure en anneau et la structure linéaire réside dans le fait que l'anneau comporte une redondance intégrée contre les anomalies de supports de transmission (par exemple, rupture de câble). Il convient par conséquent de l'utiliser de manière préférentielle.

Chaque maître traite uniquement un seul réseau. Dans la topologie linéaire, le maître a besoin d’un seul port. Dans la topologie en anneau, le maître doit prendre en charge deux ports.

NOTE Une unité de commande peut comporter une ou plusieurs interfaces maîtres selon la configuration.

Des interfaces de communication de Type 19 doivent être utilisées pour la connexion des esclaves au réseau de Type 19. Au niveau de la couche physique, une interface de communication de Type 19 représente la connexion entre un ou plusieurs esclaves au réseau de Type 19. Logiquement, une interface de communication de Type 19 comportant plusieurs esclaves doit réagir de manière identique à plusieurs interfaces de même nature comportant chacune un seul esclave. La communication cyclique peut se produire entre tous les appareils de Type 19 d’un réseau de même type.

La disposition physique des esclaves dans le réseau est indépendante des adresses d’appareils prédéfinies pour les esclaves, ainsi que de la séquence des champs de données en temps réel dans les télégrammes MDT et AT.

Tout esclave est capable de reconnaître à tout moment la topologie utilisée, sur la base de la différence entre les télégrammes primaires et secondaires. Cette disposition est importante lorsqu'on ajoute un esclave à la communication à un moment ultérieur (par exemple, lors de l'ajout de nouvelles parties de machine, avec connexion à chaud). Lorsqu'un esclave reçoit des télégrammes avec le même Type 19 sur les deux ports (MDT0-P ou MDT0-S), il reconnaît une ligne. Lorsqu'il reçoit un MDT0-P sur un port et un MDT0-S sur l'autre port, il reconnaît un anneau.

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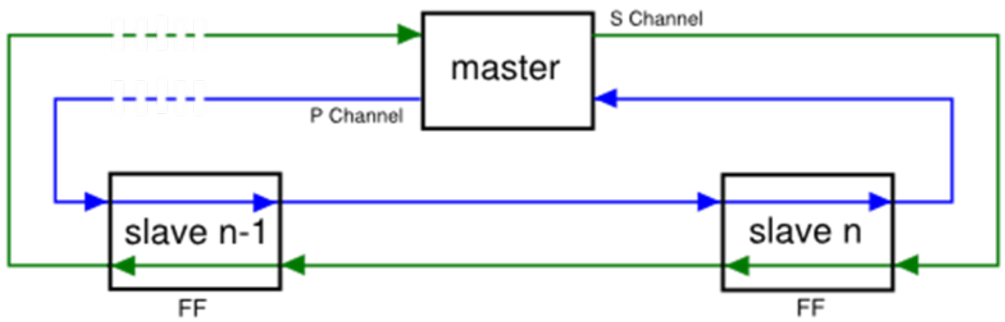
5.3.2 Topologie en anneau

Cette topologie doit consister en un canal principal et un canal secondaire. Tous les esclaves fonctionnent en mode acheminement rapide (voir Figure 13). Cet anneau permet la redondance de protection contre le défaut de câble (par exemple, déconnexion ou rupture de câbles non souhaitée). L'ouverture de l'anneau et l'insertion/retrait d'esclaves en fonctionnement (connexion à chaud) sont également possibles. En cas de rupture de câble au port 1, l'esclave doit activer le bouclage avec acheminement au port 2 et inversement.



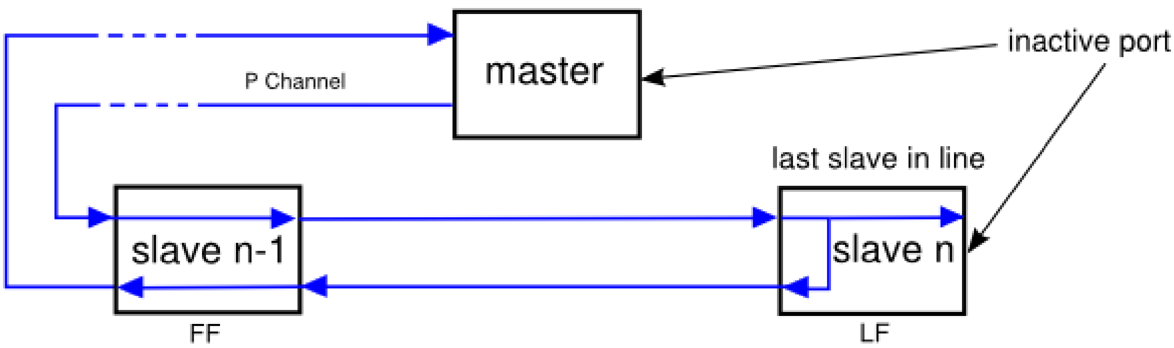
Légende

Anglais	Français
Master	Maître
Slave	Esclave
P channel	Canal P

Figure 13 – Topologie en anneau avec le Canal P&S

5.3.3 Topologie linéaire

Cette topologie consiste en un canal principal ou un canal secondaire, selon la configuration. Le dernier esclave physique effectue le bouclage avec la fonction acheminement. Tous les autres esclaves fonctionnent en mode acheminement rapide. L'ajout ou le retrait d'esclaves en fin de ligne en fonctionnement (connexion à chaud) est également possible. En cas de rupture de câbles à un port, l'esclave doit toujours activer le bouclage avec acheminement à ce port, où il reçoit un MST en premier lieu (voir Figure 14).



Légende

Anglais	Français
Master	Maître
Slave	Esclave
P channel	Canal P
Last slave in line	Dernier esclave en ligne
Inactive port	Port inactif

Figure 14 –Exemple de topologie linéaire avec le canal P

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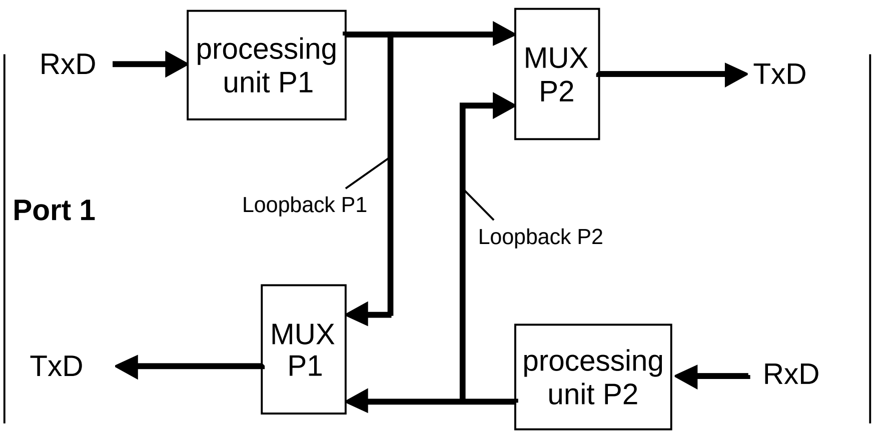
Si aucun appareil d'Ethernet ou aucun appareil de Type 19 n'est connecté ou si une rupture d'anneau survient sur le port, le port est alors appelé port inactif. Le port inactif

- doit recevoir les télégrammes Ethernet éventuels.
- peut prendre en charge l'intégration d'un télégramme de Type non 19 reçu dans le réseau de Type 19.
- doit réagir aux télégrammes de Type 19 et évaluer le MST.
- doit transmettre les télégrammes UC, ainsi que les télégrammes de Type 19.
- doit définir des bits correspondants dans l'état d'appareil pour prendre en charge la récupération de l'anneau.
- doit utiliser la synchronisation de Type 19 du port actif.

5.3.4 Conditions de topologie d'un appareil esclave

Chaque port d'un esclave doit être attribué à une unité de traitement et un multiplexeur (voir Figure 15). Les fonctions de l'esclave doivent dépendre de la topologie et du créneau interne au cycle de communication (canal RT ou canal UC, voir Figure 59).

Le maître comporte une seule unité de traitement pour chaque port (ni multiplexage et ni bouclage).



Légende

Anglais	Français
Processing unit	Unité de traitement
Loopback	Bouclage

Figure 15 – Schéma de principe d'un esclave

- Cas 1: Au cours de l'état NRT, un esclave en mode NRT doit activer le bouclage avec mode acheminement sur le port sur lequel il reçoit le premier MST.
- Cas 2: Pendant la phase CP0, un esclave à l'état de bouclage avec mode acheminement doit désactiver le bouclage et activer l'acheminement rapide dès qu'il reçoit le MST sur les deux ports.
- Cas 3: Pendant la phase CP0, un esclave en mode acheminement rapide doit activer le bouclage sur un port dès qu'il ne reçoit pas de MST sur l'autre port pendant la temporisation MST (130 ms).
- Cas 4: Pendant la phase CP0, un esclave à l'état de bouclage avec mode acheminement doit désactiver le bouclage et activer le mode NRT dès qu'il ne reçoit pas de MST sur le port actif pendant la temporisation MST (130 ms).
- Lorsque l'esclave reconnaît la commutation de phase (CPS = 1, CP = 1), il doit interrompre le changement automatique de topologie.

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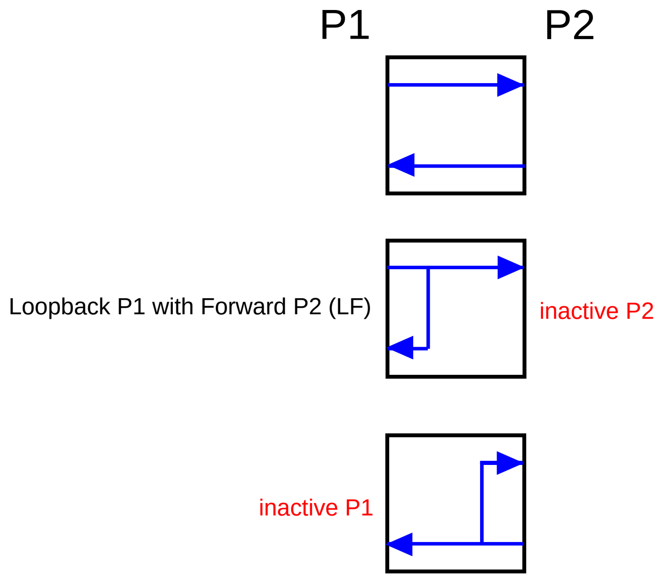
Un esclave peut adopter 3 conditions de topologie dans le canal RT (voir Figure 16):

- acheminement rapide (condition normale)
- bouclage P1 avec acheminement (ligne de réception interrompue sur P2)
- bouclage P2 avec acheminement (ligne de réception interrompue sur P1)



Légende

Anglais	Français
Loopback P1 with Forward P2 (LF)	Bouclage avec Acheminement P2 (LF)
Inactive	Inactif

Figure 16 – Conditions de topologie d'un esclave

5.3.5 Conditions de topologie d'un appareil à esclaves multiples

Un appareil à esclaves multiples consiste en plusieurs esclaves comme l'illustre la Figure 17. Les fonctions suivantes doivent être prises en charge par l'appareil et les esclaves :

- S-0-1046 (Liste des adresses d'appareil dans l'appareil) doit être prise en charge par chaque esclave.
- S-0-1037 (Instabilité de l'esclave) doit être prise en charge par chaque esclave et doit contenir la même valeur.
- Gestion de topologie, du compteur de séquences dans la phase CP0, de l'Etat d'appareil (S-DEV) et de la Commande d'appareil (C-DEV), tel que décrit en 5.3.5.
- Désactivation des esclaves internes à un appareil à esclaves multiples:
  - Si une application ne nécessite pas l'utilisation de tous les esclaves internes à un appareil à esclaves multiples, on doit alors désactiver les esclaves non utilisés.
  - Au moins, un esclave doit être toujours en état actif, dans la mesure où il doit gérer la topologie (par exemple, redondance, etc.)
  - La fonction de désactivation et d'activation des esclaves internes à un appareil à esclaves multiples est spécifique au fabricant.

Chacun des esclaves d'un appareil à esclaves multiples doit comporter une adresse de sous-appareil saisie soit lors de la mise sous tension, ou qui peut être définie par une unité d'entrée externe telle qu'un commutateur ou un panneau DIP.

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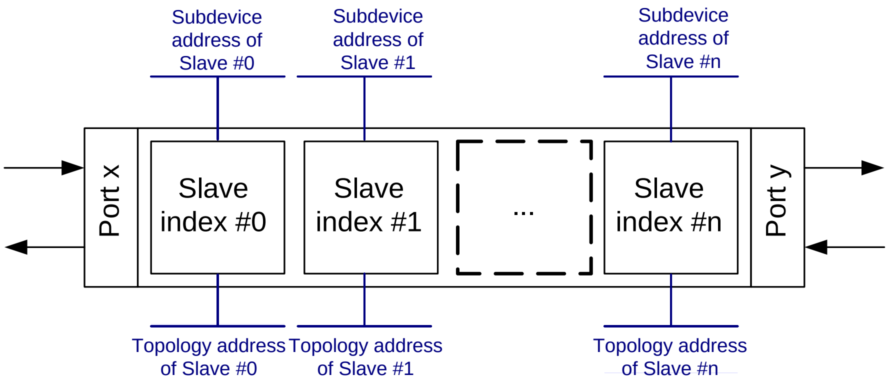
Chaque esclave détermine sa position dans la topologie (adresse de topologie) dans la phase CP0. Il est nécessaire de déterminer l'index de topologie conforme à un appareil à esclaves multiples. Cette détermination doit être indépendante de la méthode de connexion des deux ports de l'appareil et du type de topologie présente.



Légende

Anglais	Français
Subdevice address of Slave	Adresse de sous-appareil de l'Esclave
Slave index	Index d'esclave
Topology address of Slave	Adresse de topologie de l'Esclave

Figure 17 – Adressage d'un appareil à esclaves multiples

Il est spécifié que le câble des ports 1 et 2 est interchangeable sans que le maître ne détecte un changement dans l'ordre de la topologie. Pour cette raison, un appareil à esclaves multiples doit intégrer les adresses de sous-appareil dans un ordre différent dans l'AT0 en phase CP0, selon la topologie présente.

Il est également spécifié que l'ordre logique correspond à l'appareil à esclaves multiples illustré à la Figure 18. L'esclave à proximité immédiate du port x est l'esclave #0 et au plus petit index de topologie dans l'appareil à esclaves multiples. Il suit ensuite l'esclave #1, etc. jusqu'à l'esclave #n ayant l'adresse de topologie la plus longue, située directement sur le port y.

L'attribution du port x et du port y sur le port 1 et le port 2 réels, repose sur le compteur de séquences reçu de l'AT0 en phase CP0. Ceci permet de remplacer l'ordre interne des esclaves de l'appareil à esclaves multiples. L'attribution entre l'adresse de l'esclave et l'adresse de sous-appareil est fixe, et l'index de topologie doit être déterminé. De plus, il est supposé, dans l'AT0 de la phase CP0, que le compteur de séquences reçu du port 1 est appelé SEQCNT-P1 et que le compteur de séquences reçu du port 2 est appelé SEQCNT-P2.

Les scénarii de topologie suivants sont possibles:

- Topologie en anneau et linéaire: l'appareil à esclaves multiples se situe dans un anneau ou n'est pas le dernier dans une ligne (voir Figure 18).
- Topologie linéaire: l'appareil à esclaves multiples est le dernier dans la ligne (voir Figure 19).

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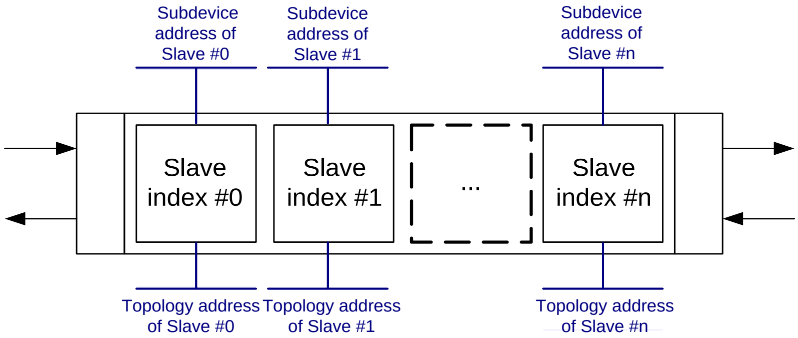
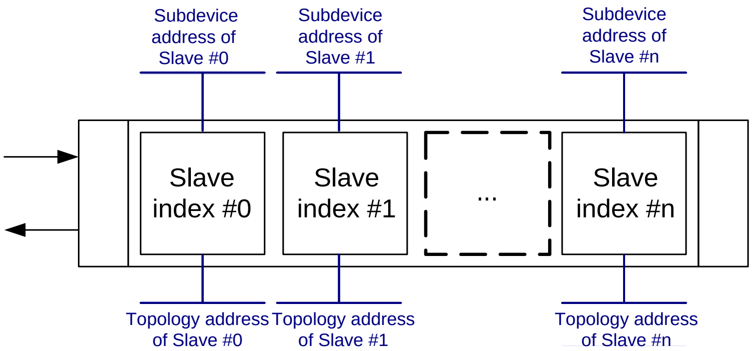


Légende

Anglais	Français
Subdevice address of Slave	Adresse de sous-appareil de l'Esclave
Slave index	Index d'esclave
Topology address of Slave	Adresse de topologie de l'Esclave

Figure 18 – Appareil à esclaves multiples dans la topologie en anneau ou qui n'est pas le dernier appareil dans la topologie linéaire



Légende

Anglais	Français
Subdevice address of Slave	Adresse de sous-appareil de l'Esclave
Slave index	Index d'esclave
Topology address of Slave	Adresse de topologie de l'Esclave

Figure 19 – Appareil à esclaves multiples constituant le dernier appareil dans la topologie linéaire

Détermination des index de topologie d'un appareil à esclaves multiples

Le Tableau 61, le Tableau 62 et le Tableau 63 contiennent les scénarii de topologie linéaire et en anneau, avec l'attribution des index de topologie pour les esclaves #0 à #n.

Tableau 61 – Détermination des index de topologie (1)

Télégramme de Type 19 sur P1 & P2	P1.SEQCNT.bit15 ≠ P2.SEQCNT.bit15	P1.SEQCNT.bit15 = 0	P1.SEQCNT.bit15 = 1
Topologie	Anneau	pas le dernier dans la ligne	pas le dernier dans la ligne
Séquence des index de topologie	non inversé ⇒	non inversé ⇒	inversé ⇐

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Tableau 62 – Détermination des index de topologie (2)

Télégramme de Type 19 sur P1 uniquement	P1.SEQCNT.bit15 = 0	P1.SEQCNT.bit15 = 1
Topologie	dernier dans la ligne (P1)	dernier dans la ligne (P1)
Séquence des index de topologie	non inversé ⇒	inversé ⇐

Tableau 63 – Détermination des index de topologie (3)

Télégramme de Type 19 sur P2 uniquement	P2.SEQCNT.bit15 = 0	P2.SEQCNT.bit15 = 1
Topologie	dernier dans la ligne (P2)	dernier dans la ligne (P2)
Séquence des index de topologie	non inversé ⇒	inversé ⇐

En raison de l'attribution décrite des index de topologie, le comportement apparaît également dans l'état de topologie (S-DEV) et le contrôle de topologie (C-DEV) des esclaves d'un appareil à esclaves multiples.

L'esclave ayant l'index de topologie la plus courte et l'esclave ayant l'index de topologie la plus longue (esclave #0 et esclave #n), doivent évaluer les bits de topologie de la commande d'appareil (C-DEV) et doivent définir les bits de même nature dans l'état d'appareil (S-DEV). Tous les autres esclaves ne sont que virtuels par rapport à la topologie, et sont toujours dans l'état d'acheminement rapide, et ne doivent par ailleurs pas évaluer les bits de topologie dans la commande d'appareil. Ils ne doivent pas non plus modifier l'état d'acheminement rapide dans l'état d'appareil.

Selon les télégrammes P ou S reçus sur les deux ports, l'état de topologie des deux esclaves (esclave #0 et esclave #n) est présenté dans le Tableau 64.

Tableau 64 – Etat de topologie d'un appareil à esclaves multiples

Topologie	Etat de topologie (C-DEV)		
	Esclave #0	Esclave #1 à #n-1	Esclave #n
voir Figure 20	acheminement rapide	acheminement rapide	bouclage avec Acheminement
voir Figure 21	bouclage avec acheminement	acheminement rapide	acheminement rapide
voir Figure 22	acheminement rapide	acheminement rapide	acheminement rapide

Les paramètres de topologie admis d'un appareil à esclaves multiples sont présentés dans le Tableau 65. Dans une topologie en anneau, le maître n'est pas autorisé à régler les deux esclaves (proches des ports) sur l'état de bouclage avec acheminement simultanément.

Tableau 65 – Paramètres de topologie d'un appareil à esclaves multiples

Topologie	Paramètres de topologie admis (C-DEV)		
	Esclave #0	Esclave #1 à #n-1	Esclave #n
voir Figure 20	acheminement rapide	acheminement rapide	bouclage avec acheminement ou acheminement rapide, par exemple lors de la connexion à chaud, de la récupération de l'anneau, etc.
voir Figure 21	bouclage avec acheminement ou acheminement rapide, par	acheminement rapide	acheminement rapide

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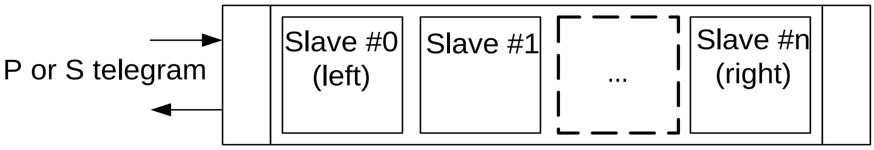
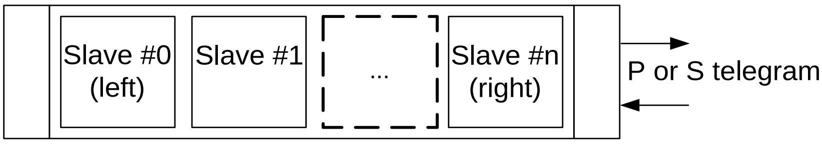
Topologie	Paramètres de topologie admis (C-DEV)		
	Esclave #0	**Esclave #1 à #n-1**	**Esclave #n**
	exemple lors de la connexion à chaud, de la récupération de l'anneau, etc.		
voir Figure 22	acheminement rapide ou bouclage avec acheminement, ne doit pas être activé simultanément dans l'esclave #n	acheminement rapide	acheminement rapide ou bouclage avec acheminement, ne doit pas être activé simultanément dans l'esclave #0



Légende

Anglais	Français
P or S telegram	Télégramme P ou S
Slave	Esclave
(left)	(gauche)
(right)	(droit)

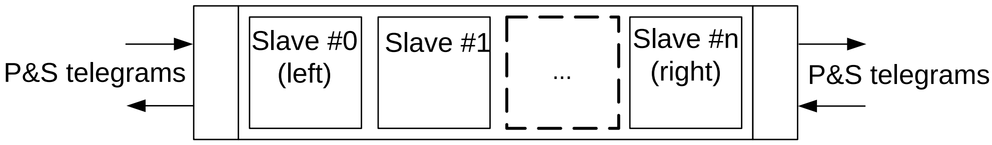
Figure 20 – Appareil à esclaves multiples en ligne (gauche)



Légende

Anglais	Français
P or S telegram	Télégramme P ou S
Slave	Esclave
(left)	(gauche)
(right)	(droit)

Figure 21 – Appareil à esclaves multiples en ligne (droite)



Légende

Anglais	Français
P&S telegram	Télégrammes P&S
Slave	Esclave
(left)	(gauche)
(right)	(droit)

Figure 22 – Appareil à esclaves multiples en anneau

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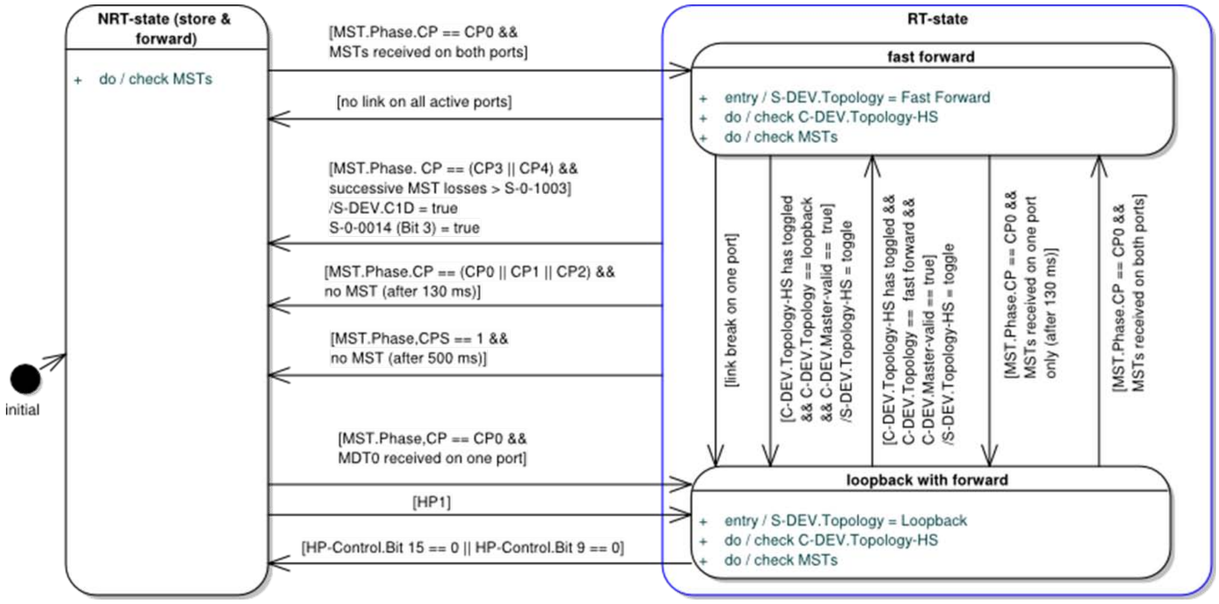
5.3.6 Diagramme d’états de topologie

Le diagramme d'états de topologie d’un esclave doit comporter deux états, à savoir l’état NRT et l’état RT (voir Figure 23).

- Etat NRT
  - Le mode NRT est activé pendant l’état NRT. L’esclave doit vérifier et évaluer le MST.
  - Fonctionnalité d’un appareil de Type 19 en mode NRT:
    - i) La communication Ethernet standard doit être active, lorsqu’elle est prise en charge.
    - ii) La fonction ‘store&forward’ au moins doit être prise en charge par l’appareil, mais la fonction ‘cut-through’ peut toutefois être également prise en charge
    - iii) Les données issues de RXD (P1) doivent être transmises avec ou sans modification à TXD (P2). Les données issues de RXD (P2) doivent être transmises avec ou sans modification à TXD (P1).
  - Le mode NRT doit être activé pendant l’état NRT, la phase HP0 ou dans le canal UC
- Etat RT
  - comporte deux sous-états, à savoir l’état "acheminement rapide" et l’état "bouclage avec acheminement".

NOTE la commutation du canal RT sur le canal UC et inversement (au temps t6 et t7 respectivement) ne fait pas partie intégrante de ce diagramme d’états (voir 7.1.10).



Légende

Anglais	Français
NRT –state (store & forward)	Etat NRT (archiver & acheminer)
MSTs received on both ports	MST reçus sur les deux ports
RT-state	Etat RT
Fast forward	Acheminement rapide
no link on all active ports	Pas de liaison sur tous les ports actifs
Link break on one port	Coupure de liaison sur un port
MDT0 received on one port	MDT0 reçu sur un port
Loopback with forward	Bouclage avec cheminement
After 130 ms	Après 130 ms

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Anglais	Français
After 500 ms	Après 500 ms

Figure 23 – Diagramme d'états de topologie d'un esclave

5.3.7 Etats du diagramme d'états de topologie d'un esclave

Les états du diagramme d'états sont décrits dans le Tableau 66. La configuration des DEL doit être ajustée sur l'état de topologie correspondant.

Tableau 66 – Etats du diagramme d'états de topologie d'un esclave

Etat	Description
état NRT : (Mode NRT est actif)	• A leur mise sous tension, le maître et chaque esclave doivent activer l'état NRT de manière indépendante. • Le mode NRT est activé pendant l'état NRT. • La mémoire tampon de collision doit être administrée tel qu'il est décrit dans le diagramme d'états de topologie. • Le maître doit quitter l'état NRT pour CP0 sur demande de son utilisateur DL. • L'esclave doit vérifier le MST des télégrammes de Type 19. Lorsque l'esclave reconnaît un - MST avec CP = 0, il doit alors activer CP0 et modifier la topologie (voir 5.3.6). - MST avec CP = 4, il doit alors activer HP0, si la connexion à chaud est prise en charge. • Avant d'entrer dans l'état NRT à partir d'un état différent de CP0 ou HP0, l'esclave doit générer une liaison descendante sur les deux ports. • Dans l'état NRT, l'esclave peut activer la configuration #1 des DEL de Type 19.
état RT (Acheminement rapide)	• L'esclave doit transmettre les données reçues avec ou sans modification de l'autre port, avec un retard généré par tREP. • L'esclave doit régler l'état d'acheminement rapide dans l'état d'appareil (bits 13 et 12 = 0). • L'esclave doit vérifier la topologie HS dans la commande d'appareil (bit 14). • L'esclave doit vérifier et évaluer le MST. • Le maître ne comporte pas de fonctionnalité d'acheminement rapide.
état RT (Bouclage avec Acheminement)	• Les données reçues doivent être transmises avec ou sans modification des deux ports. • Le bouclage avec acheminement peut être activé à P1 ou P2 selon la topologie, mais non aux deux ports simultanément. • Lorsque l'esclave est le dernier esclave physique de la topologie linéaire, il doit alors activer le bouclage avec acheminement uniquement sur le port en provenance duquel il reçoit les télégrammes MST. • L'esclave doit régler l'état de bouclage avec acheminement selon la topologie de l'état d'appareil (bit 13 et 12 = 01 ou 10). • L'esclave doit vérifier la topologie HS dans la commande d'appareil (bit 14). • L'esclave doit vérifier et évaluer le MST • Le maître ne comporte pas de fonctionnalité de bouclage avec acheminement.

5.3.8 Transitions du diagramme d'états de topologie

Les transitions du diagramme d'états sont décrites dans le Tableau 67, le Tableau 68 et le Tableau 69. En phase CP0, l'esclave doit activer la transition de topologie au temps T7cp0. Dans les phases CP1 à CP4, l'esclave peut activer la transition de topologie le plus rapidement possible. Une fragmentation des télégrammes peut se produire si l'on ne tient pas compte du trafic pour la transition de topologie.

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Tableau 67 – Transitions du diagramme d'états de topologie

Transition			Description
Source	**Cible**	**Condition**	
état NRT	Acheminement rapide	CP équivaut à CP0 && MST reçus sur les deux ports	En état NRT, l'esclave doit activer l'état d'acheminement rapide, dès que les MST avec CP0 ont été reçus sur les deux ports.
état NRT	Bouclage avec Acheminement	CP équivaut à CP0 && MST reçus sur un port	En état NRT, l'esclave doit activer l'état de bouclage avec acheminement, dès qu'un MST avec CP0 a été reçu sur un port, mais uniquement tant qu'aucun MST n'a été reçu sur l'autre port.
Bouclage avec Acheminement	Acheminement rapide	CP équivaut à CP0 && MST reçus sur les deux ports	Pendant la phase CP0, un esclave à l'état de bouclage avec acheminement doit désactiver le bouclage avec acheminement et activer l'acheminement rapide dès qu'il reçoit un télégramme MST sur les deux ports.
Acheminement rapide	Bouclage avec Acheminement	CP équivaut à CP0 && MST reçus sur un seul port dans un délai de 130 ms	Pendant la phase CP0, un esclave à l'état d'acheminement rapide doit activer le bouclage avec acheminement sur un port dès qu'il ne reçoit pas de télégramme MST sur l'autre port au cours de la temporisation MST (130 ms).
état NRT	Bouclage avec Acheminement	HP1	L'esclave de connexion à chaud a reçu tous les paramètres HP0 et active l'état de bouclage avec acheminement.
état RT	état NRT	Pas de télégramme MST au cours de la temporisation MST (130 ms) && CP équivaut à (CP0, CP1, CP2, HP1, HP2)	Si l'esclave ne reçoit pas de télégrammes MST au cours de la temporisation MST en phase CP0, CP1, CP2, HP1 ou HP2, il active alors l'état NRT.
Bouclage avec Acheminement	Acheminement rapide	C-DEV.Topology-HS = commutation && C-DEV.Topology = acheminement rapide && C-DEV.Master-valid = 1	Le maître commande l'état d'acheminement rapide. • Si l'esclave détecte encore une liaison de Type 19 sur le port inactif, l'esclave doit alors commuter sur S-DEV.Topology-HS, activer l'Acheminement rapide et doit définir en conséquence l'état S.DEV port. L'esclave doit annuler l'avertissement 0xC30E4020 dans S-0-0390 (Numéro de diagnostic). • Si l'esclave ne détecte pas une liaison de Type 19 sur le port inactif, l'esclave doit alors commuter sur S-DEV.Topology-HS, conserver l'état Bouclage avec acheminement et ne doit pas modifier l'état S.DEV.port
Acheminement rapide	Bouclage avec Acheminement	C-DEV.Topology-HS = commutation && C-DEV.Topology = bouclage avec acheminement && C-DEV.Master-valid = 1	Le maître commande l'état de bouclage avec acheminement, l'esclave commute sur S-DEV.Topology-HS.
Bouclage avec Acheminement	état NRT	(HP-Control.Bit 15 = 0) ou (HP-Control.Bit 9 = 0)	Le maître annule la fonction de connexion à chaud.

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Tableau 68 – Transitions du diagramme d'états de topologie (transitions avec avertissement)

Transition avec avertissement			Description
Source	**Cible**	**Condition**	
Acheminement rapide	Bouclage avec Acheminement	rupture de liaison sur un port	Un défaut de câble (par exemple: déconnexion, rupture de câble non souhaitée) est détecté sur un port. Si CP > CP0, l'esclave doit générer un avertissement (S-DEV.Bit 6 = 1), régler S-0-0390 (Numéro de diagnostic) sur 0xC30E4020; il active également l'état de bouclage avec acheminement.

Tableau 69 – Transitions du diagramme d'états de topologie (transitions avec erreur)

Transition avec erreur			Description
Source	**Cible**	**Condition**	
état RT	état NRT	Pas de liaison sur tous les ports actifs	Si CP > CP0, l'esclave doit générer une erreur (S-DEV, bit 7 = 1), règle S-0-0390 (Numéro de diagnostic) sur 0xC30F4020 et active l'état NRT.
état RT	état NRT	MST.Phase.CPS = 1 &&, pas de télégramme MST dans le délai CPS-MST (500 ms)	Si la temporisation CPS-MST se produit lors de la commutation de phase, l'esclave génère une erreur (S-DEV, bit 7 = 1), règle S-0-0390 (Numéro de diagnostic) sur 0xC30F4017 et active l'état NRT.
état RT	état NRT	Pertes MST> S-0-1003 (Pertes MST admises en CP3&CP4 && CP correspond à (CP3 ou CP4)	Si les pertes MST en CP3 ou CP4 dépassent la valeur de S-0-1003 (Pertes MST admises) en CP3&CP4, l'esclave règle alors S-DEV.C1D-error = 1, S-0-0014.Bit 3 = 1, s'il est pris en charge et règle S-0-0390 (Numéro de diagnostic) sur 0xC30F4001 et active l'état NRT.

5.4 Redondance de la communication RT avec topologie en anneau

5.4.1 Introduction

Le maître doit transmettre tous les télégrammes avec le même contenu sur le canal P et sur le canal S (voir Figure 24). De la même façon, le maître doit recevoir à deux reprises les télégrammes en provenance des esclaves, et traiter la SVC et les données en temps réel d'un seul télégramme reçu valide uniquement (télégramme P ou S). Si le maître ne reçoit pas le télégramme sélectionné, il doit alors traiter la SVC et les données en temps réel de l'autre télégramme.

Chaque esclave doit recevoir les deux télégrammes, fonctionner sur les champs de données attribués dans les canaux P et S, et transmettre ces télégrammes à leurs canaux respectifs.

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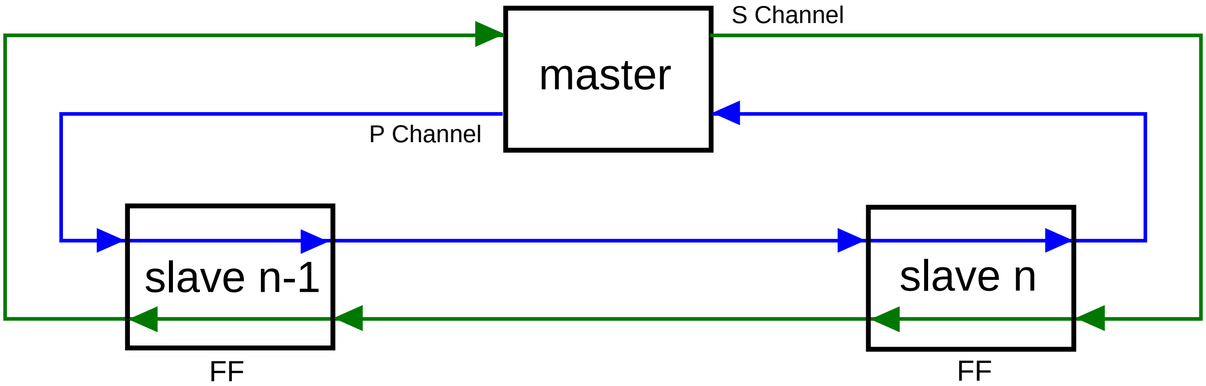


Légende

Anglais	Français
S channel	Canal S
Master	Maître
P channel	Canal P
Slave	Esclave

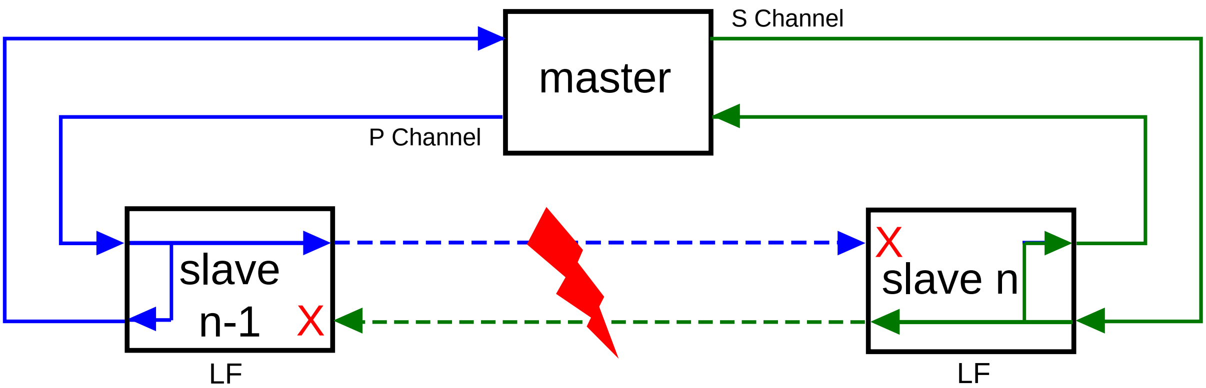
Figure 24 – Anneau sans rupture

5.4.2 Séquence avec rupture d'anneau

Après une rupture de câble, l'esclave doit commuter de l'état d'acheminement rapide à l'état de bouclage avec acheminement dans un délai inférieur à la durée minimale du cycle de communication (tScyc, S-0-1002) et signaler le changement de topologie dans l'état d'appareil (bits 14 – 12).

L'esclave active le bouclage toujours sur le port non perturbé, et les télégrammes RT reçus sont de ce fait renvoyés au maître et acheminés simultanément sur le port perturbé.

En cas de rupture d'anneau, ce dernier se désintègre en 1 ou 2 lignes (voir Figure 25 et Figure 26).



Légende

Anglais	Français
S channel	Canal S
Master	Maître
P channel	Canal P
Slave	Esclave

Figure 25 – Rupture d'anneau

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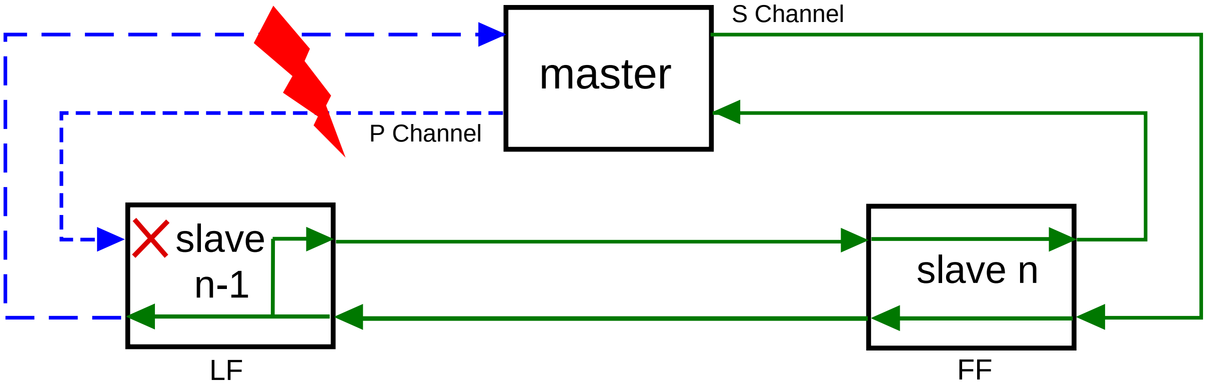
Le maître envoie des télégrammes P et reçoit des télégrammes S sur un port. A l'autre port, le maître envoie des télégrammes S et reçoit des télégrammes P (voir Figure 24).

Lorsqu'un esclave change la topologie, cette opération est reconnue par le maître, étant donné que ce dernier envoie et reçoit des télégrammes P sur un port et envoie et reçoit des télégrammes S sur l'autre port (voir Figure 25).

En cas de rupture de câble entre le maître et l'esclave, ce dernier change la topologie, cette opération étant reconnue par le maître, étant donné que ce dernier envoie et reçoit, par exemple, des télégrammes P sur un port et envoie des télégrammes S, mais ne reçoit aucun télégramme sur l'autre port (voir Figure 26). Il faut que le maître analyse l'état d'appareil de tous les esclaves afin de montrer l'interruption de connexion.

Recommandation: aux fins de diagnostic, il convient que maître enregistre dans un paramètre toutes les liaisons interrompues (par exemple, rupture de câble entre l'esclave n-1 et l'esclave n) avec les adresses de sous-appareil, les adresses de topologie, la date et l'heure.



Légende

Anglais	Français
S channel	Canal S
Master	Maître
P channel	Canal P
Slave	Esclave

Figure 26 – Rupture d'anneau sur le maître

5.4.3 Récupération de la topologie en anneau

L'esclave contrôle les deux ports et présente l'état des ports dans l'état d'appareil (S-DEV). Avec cette information, le maître reconnaît que l'interruption a été supprimée. Avant que le maître puisse fermer l'anneau, il doit vérifier que le télégramme P ou S est reçu sur le port inactif de l'esclave correspondant (voir S-DEV, bits 11 et 10).

L'esclave doit fermer uniquement l'anneau, si le maître commande cette opération dans la commande d'appareil (C-DEV). Les canaux P et S peuvent être fermés l'un après l'autre ou simultanément (voir 5.4.4 et 5.4.5).

Lorsque le maître a fermé le canal P et le canal S, l'établissement de l'anneau est achevé. Après récupération de l'anneau en CP4, et avec une synchronisation active, le maître doit transmettre S-0-1015 (Retard de l'anneau de la topologie) à tous les esclaves de synchronisation. Ensuite, le maître doit activer S-0-1024 (Commande de procédure de mesure de retard SYNC) pour annoncer à l'esclave qu'il peut effectuer à nouveau la synchronisation sur les deux ports.

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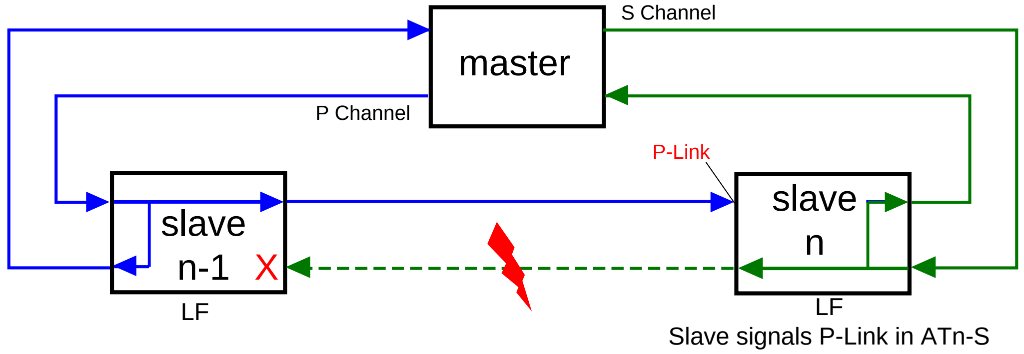
Pour prendre en charge la commutation IP, le maître doit transmettre les paramètres du créneau du canal UC dans le champ HP MDT à l'aide de l'adresse de diffusion. Le maître doit, directement après le début de la phase CP3 et immédiatement après récupération de l'anneau, transmettre t6 et t7 avec les cycles d'analyse définis de chaque paramètre. Le contenu du champ HP MDT est présenté au Tableau 52.

5.4.4 Récupération du canal P

A la Figure 27, l'esclave n reconnaît qu'il reçoit à nouveau des télégrammes P et indique cette situation dans l'état d'appareil du canal S.



Légende

Anglais	Français
S channel	Canal S
Master	Maître
P channel	Canal P
Slave	Esclave
P link	Liaison P
Slave signals P-Link in ATn-S	Liaison P de signal d'esclave dans ATn-S

Figure 27 – Récupération du canal P (1)

Il est désormais possible, pour le maître, de changer la topologie de l'esclave n entre le bouclage avec acheminement et l'acheminement rapide (voir Figure 28), afin de rétablir le canal P.

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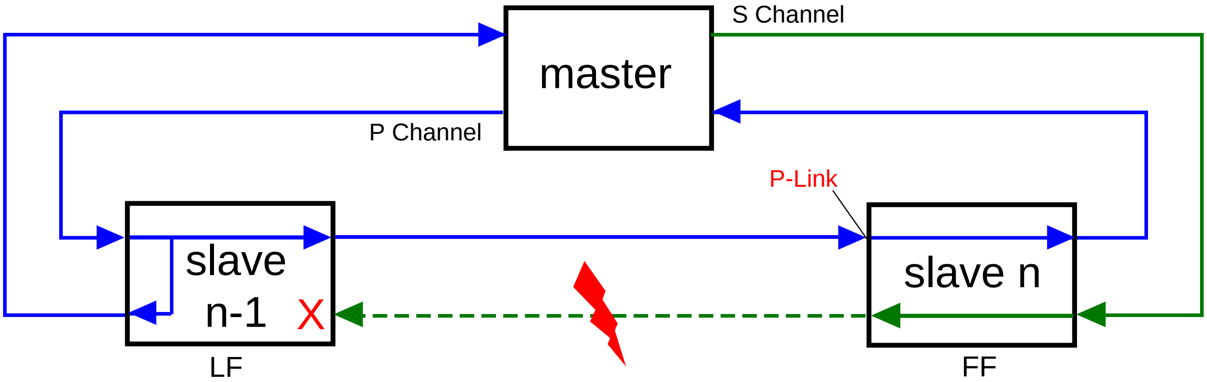


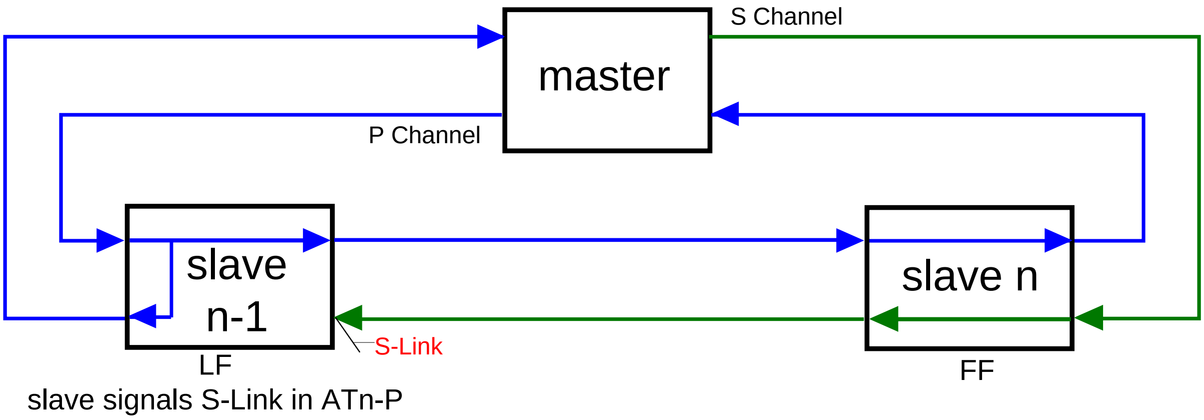
Légende

Anglais	Français
S channel	Canal S
Master	Maître
P channel	Canal P
Slave	Esclave
P link	Liaison P

Figure 28 – Récupération du canal P(2)

5.4.5 Récupération du canal S

A la Figure 29, l'esclave n-1 reconnaît qu'il reçoit des télégrammes S et indique par ailleurs cette situation dans l'état d'appareil du canal P.



Légende

Anglais	Français
S channel	Canal S
Master	Maître
P channel	Canal P
Slave	Esclave
S link	Liaison S
Slave signals S-Link in ATn-P	Liaison S de signal d'esclave dans ATn-P

Figure 29 – Récupération du canal S (1)

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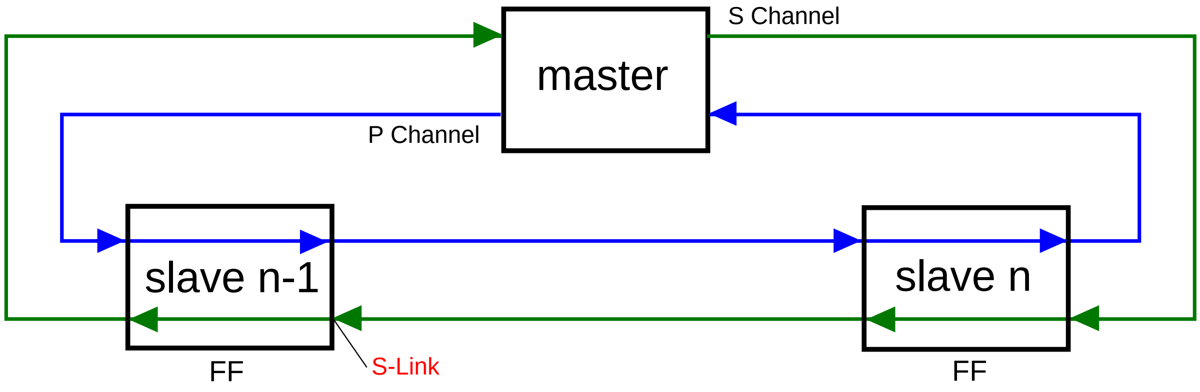
Le maître peut désormais changer la topologie de l'esclave n-1 entre le bouclage avec acheminement et l'acheminement rapide (voir Figure 30), afin de rétablir le canal S.



Légende

Anglais	Français
S channel	Canal S
Master	Maître
P channel	Canal P
Slave	Esclave
S link	Liaison S

Figure 30 – Récupération du canal S (2)

5.5 Procédure de connexion à chaud

5.5.1 Introduction

Sur demande Enable_Hotplug (EHP) par l'utilisateur DL dans l'appareil maître, une liste des appareils prévus qui peuvent faire l'objet d'une connexion à chaud (selon l'application), est transmise à la DL. L'utilisateur DL est informé de la connexion à chaud éventuelle d'un nouvel appareil par une Notify_Device_Status_Change (NDSC).

Le mécanisme de connexion à chaud prévoit la capacité de conduire les appareils comportant un ou plusieurs esclaves (appareil à esclaves multiples) à la phase CP4 subséquemment. Le réseau de Type 19 actif comportant le participant reste en phase CP4. La connexion à chaud est prise en charge en CP4 avec la topologie linéaire uniquement. Avec la topologie en anneau, il faut qu'une rupture de l'anneau soit produite en premier lieu.

Le dernier esclave d'une topologie linéaire doit contrôler son port inactif. Lorsqu'un appareil supplémentaire est connecté, il reçoit tous les télégrammes provenant du dernier esclave.

Le maître doit être préparé pour les esclaves HP, ce qui signifie que les champs de télégrammes utilisés par les esclaves de connexion à chaud doivent être configurés dans les MDT et AT. Dans le cas d'une topologie en anneau rompu, il convient que le maître active la fonction de connexion à chaud sur un canal uniquement (P ou S).

Il existe deux méthodes différentes de participation d'un appareil esclave de Type 19 à la communication cyclique de la phase CP4. Il s'agit du "lancement de la phase de communication" avec la séquence comprise entre CP0 et CP4 et de la "Procédure de connexion à chaud" avec la séquence comprise entre HP0 et HP2 et la commutation sur CP4.

Un appareil supplémentaire doit commencer en état NRT ("store and forward") ("archiver et acheminer") tel que décrit en état temps différé. Lorsque l'appareil supplémentaire prend en charge le protocole de Type 19, il doit évaluer le champ de connexion à chaud dans le MDT0.

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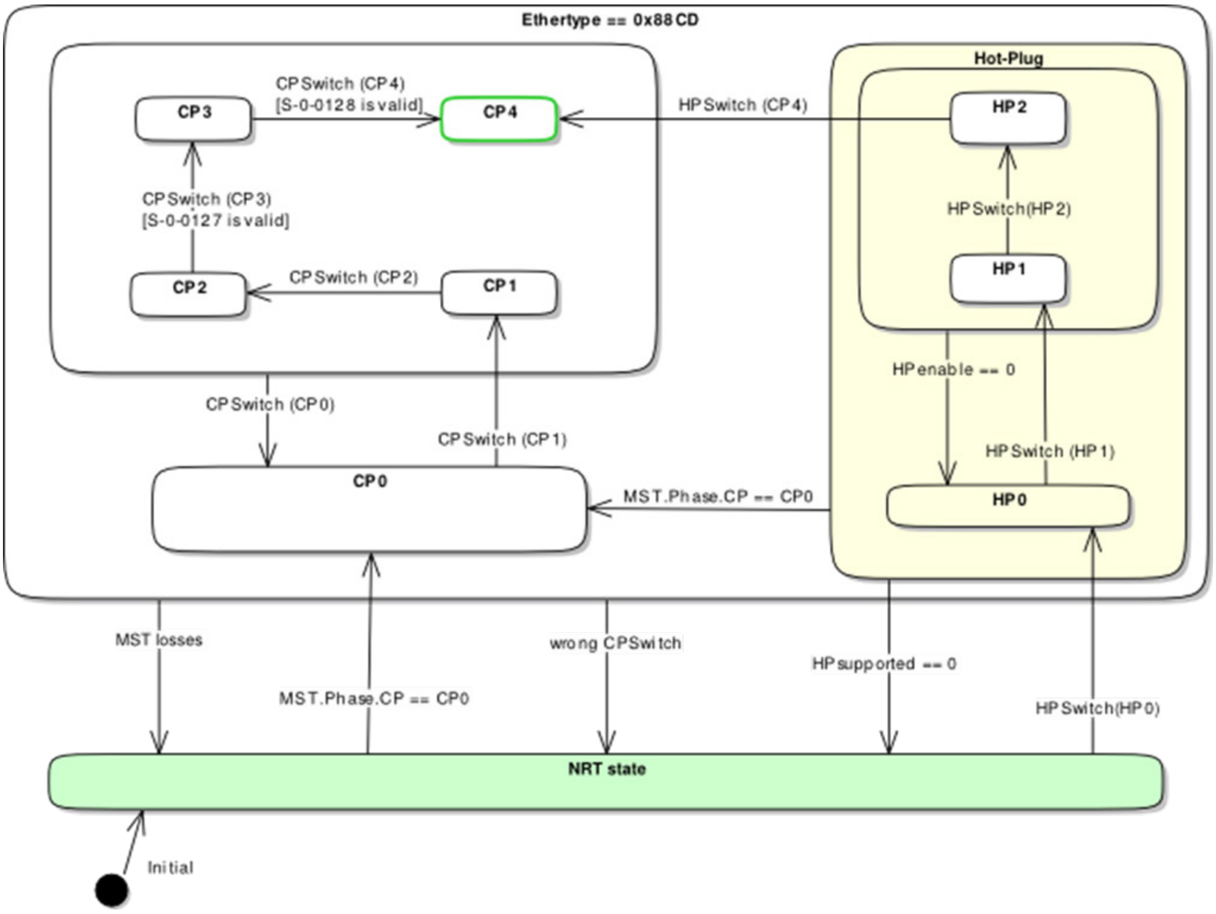
Le maître et l'esclave de connexion à chaud doivent pouvoir communiquer au moyen des champs de connexion à chaud dans les télégrammes MDT0 et AT0. Après traitement par la procédure de connexion à chaud, l'esclave de connexion à chaud doit devenir le dernier esclave de la topologie linéaire.

La procédure de connexion à chaud est divisée en 3 phases (HP0, HP1 et HP2).

5.5.2 Diagramme d'états de connexion à chaud

Le diagramme d'états de connexion à chaud est présenté sur la partie droite de la Figure 31. La configuration des DEL doit être ajustée sur les états de connexion à chaud correspondants.



Légende

Anglais	Français
Hot-Plug	Connexion à chaud
S-0-0128 is valid	S-0-0128 est valide
S-0-0127 is valid	S-0-0127 est valide
HP enable	HP actif
MST losses	Pertes MST
Wrong CPSwitch	CPSwitch erroné
HP supported	HP pris en charge
NRT state	état NRT

Figure 31 – Phase de communication et diagramme d'états de connexion à chaud

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5.5.3 Etats du diagramme d’états HP

Les états du diagramme d’états de HP sont présentés dans le Tableau 70.

Tableau 70 – Etats du diagramme d’états de HP

Etat	Description
état NRT	A leur mise sous tension, le maître et chaque esclave doivent activer l’état NRT de manière indépendante. Le mode NRT est activé pendant l’état NRT. La mémoire tampon de collision doit être administrée tel qu’il est décrit dans le diagramme d’états de topologie. Le maître doit quitter l’état NRT pour CP0 sur demande de son utilisateur DL. L’esclave doit vérifier le MST des télégrammes de Type 19. Lorsque l’esclave reconnaît un • MST avec CP = 0, il doit alors activer CP0 et modifier la topologie (voir 5.3.6). • MST avec CP = 4, il doit alors activer HP0, si la connexion à chaud est prise en charge. Avant d’entrer dans l’état NRT à partir d’un état différent de CP0 ou HP0, l’esclave doit générer une liaison descendante sur les deux ports. Dans l’état NRT, l’esclave peut activer la configuration #1 des DEL de Type 19.
HP0	En HP0, l’esclave HP est en état NRT est n’est pas capable de transmettre des télégrammes de Type 19 au maître. L’esclave HP • active le niveau de paramétrage (PL), • traite les télégrammes en mode ‘store&forward’ ou ‘cut-through’ et • évalue par ailleurs le champ MST et HP MDT. • génère la configuration #7 des DEL de Type 19. Le maître doit régler • la commande prise en charge (commande HP, bit 15=1) • la commande d’activation HP (commande HP, bit 9=1) et • lance la transmission des paramètres HP0 dans le champ HP MDT, en utilisant l’adresse de diffusion. Le maître doit répéter la transmission de chaque paramètre HP0 dans des cycles de communication successifs (tels que définis en HP1 pour l’esclave), dans la mesure où l’esclave HP ne connaît pas encore la durée du cycle de communication. Les paramètres HP0 sont communs à tous les esclaves de connexion à chaud: • Durée du cycle de communication (tScyc), S-0-1002 • Temps de transmission UC ou S-0-1017 • MTU demandée ou S-0-1027.0.1 Version de communication (MDT0 de CP0) • Longueurs des télégrammes MDT ou S-0-1010 • Longueurs des télégrammes AT ou S-0-1012 L’esclave HP doit lire uniquement les paramètres HP0. si l’adresse de diffusion (4095) est valide et la commande d’activation HP est réglée (commande HP, bit 9 = 1) par le maître. Le contenu du champ HP MDT utilisé pour transmettre les paramètres HP0 est présenté dans le Tableau 71.
HP1	Le maître doit modifier l’état de topologie du dernier esclave à partir de l’état bouclage avec acheminement à l’état acheminement rapide. L’esclave HP doit générer la configuration des LED de Type 19 ; Le maître doit analyser tous les esclaves HP de l'appareil HP (appareil à un seul esclave ou à esclaves multiples) et transmettre des paramètres HP1 individuels à chaque esclave HP

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Etat	Description
	Analyse des esclaves HP avec l'index d'esclave Définition de l'index d'esclave: Dans un appareil à un seul esclave, l'index d'esclave doit être égal à 0. Dans un appareil à esclaves multiples, l'index d'esclave doit commencer par 0, 1, 2, etc. Pendant l'analyse des esclaves HP, le maître doit régler l'adresse d'appareil sur 0. Le maître doit commencer l'analyse avec l'index d'esclave 0 et incrémente l'index de 1 pour l'esclave suivant, etc. Les cycles d'analyse de chaque paramètre sont définis comme suit : tscyc ≤ 2ms --> cycles d'analyse = (2ms/tScyc) * 10 cycles tscyc > 2ms --> cycles d'analyse = 10 cycles L'esclave HP doit s'adapter à l'index d'esclave et intègre l'adresse d'appareil correspondante dans le champ HP AT. L'esclave HP doit réagir à un changement de l'index d'esclave dans le champ HP AT dans le cadre du nombre de cycles d'analyse donné Lorsqu'un esclave HP est adressé avec l'index d'esclave non présent dans l'appareil HP, ce dernier doit régler l'adresse d'appareil sur 4093 (0xFFD) et s'adapter à l'index d'esclave dans le champ HP AT. Le maître doit terminer l'analyse des esclaves s'il reçoit 4093 comme adresse d'appareil dans le champ HP AT. Si le maître n'a pas analysé tous les esclaves HP présents, l'appareil HP envoie alors un message d'erreur dans l'état HP (bit 8=1 et code d'erreur = 5). **Transmission des paramètres HP1** Si le maître a analysé tous les esclaves HP, il doit transmettre les paramètres HP1 spécifiques à l'esclave suivants, à tous les esclaves HP d'un appareil HP. Le maître doit utiliser l'adresse d'appareil de l'esclave HP. Si l'esclave HP n'a pas détecté sa propre adresse d'appareil dans le champ HP MDT, l'esclave HP génère alors un message d'erreur dans l'état HP (bit 8=1 et code d'erreur= 4). Liste de paramètres HP1: • Décalage SVC dans le télégramme MDT ou S-0-1013; • Décalage SVC dans le télégramme AT ou S-0-1014 ; • Index de topologie ou S-0-1042. Le contenu du champ HP MDT utilisé pour transmettre les paramètres HP1 est présenté dans le Tableau 72. La réception de chaque paramètre HP1 doit être acquittée par l'esclave HP adressé (adresse HP MDT = adresse d'appareil de l'esclave HP) dans le champ HP AT. Deux cas sont possibles avec l'Index de topologie (S-0-1042). Cas 1: Si l'esclave HP ne prend pas en charge l'Index de topologie (S-0-1042), il doit alors ignorer la réception et ne doit générer aucune erreur. Cas: Si l'esclave HP prend en charge l'Index de topologie (S-0-1042) mais le maître n'a pas transmis cet index (S-0-1042), l'esclave ne doit alors générer aucune erreur. L'acquittement d'un esclave HP est présenté dans le Tableau 73.
HP2	Le maître doit configurer entièrement l'esclave HP à l'aide de la SVC (voie de service), comme décrit en phase CP2. L'esclave HP doit protéger en écriture les paramètres HP0 et HP1 et doit générer la configuration #9 des DEL de Type 19. Après la transmission des paramètres de communication selon la procédure appliquée en phase CP2, le maître doit activer le contrôle de transition CP3 ou S-0-0127. L'appareil HP doit traiter la commande de procédure comme cela est décrit sous CP2. Le maître peut transmettre des paramètres d'application tout comme en CP3 et doit produire des données en temps réel valides (par exemple, valeurs de commande).

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Tableau 71 – Champ de connexion à chaud MDT en HP0

Adresse HP MDT	Commande HP	INFO HP MDT	Description
4095 (diffusion)	0x8201	valeur de tScyc (Durée du cycle de communication)	S-0-1002 Durée du cycle de communication (tScyc)
4095	0x8202	valeur de t6 (début du canal UC)	S-0-1017 Temps de transmission du canal UC, élément de liste 0
4095	0x8203	valeur of t7 (Fin du canal UC)	S-0-1017 Temps de transmission du canal UC, élément de liste 1
4095	0x8204	Valeur de MTU	S-0-1027.0.1 MTU demandée
4095	0x8205	valeur de la Version de communication (MDT0 de CP0)	Version communication n'a aucun IDN
4095	0x8210 0x8211 0x8212 0x8213	valeur de la longueur de MDT0 valeur de la longueur de MDT1 valeur de la longueur de MDT2 valeur de la longueur de MDT3	S-0-1010 Longueur des télégrammes MDT, élément de liste 0 S-0-1010, élément de liste 1 S-0-1010, élément de liste 2 S-0-1010, élément de liste 3
4095	0x8220 0x8221 0x8222 0x8223	valeur de la longueur de AT0 valeur de la longueur de AT1 valeur de la longueur de AT2 valeur de la longueur de AT3	S-0-1012 Longueur des télégrammes, élément de liste 0 S-0-1012, élément de liste 1 S-0-1012, élément de liste 2 S-0-1012, élément de liste 3

Tableau 72 – Champ de connexion à chaud MDT en HP1

Adresse HP MDT	commande HP	INFO HP MDT	Description
adresse d'appareil d'esclave HP	0x8280	valeur de décalage SVC MDT	S-0-1013 Décalage SVC en MDT
adresse d'appareil d'esclave HP	0x8281	valeur de décalage SVC AT	S-0-1014 Décalage SVC en AT
adresse d'appareil d'esclave HP	0x8282	valeur d'Index de Topologie	S-0-1042 Index de topologie, lorsqu'il est pris en charge par le maître

Tableau 73 – Champ de connexion à chaud AT en HP1

Adresse HP AT	Etat HP	INFO HP AT	Acquittement de
adresse d'appareil de l'esclave	0x0080	sans importance ('don't care')	Décalage SVC MDT
adresse d'appareil de l'esclave	0x0081	sans importance ('don't care')	Décalage SVC AT
adresse d'appareil de l'esclave	0x0082	sans importance ('don't care')	Index de topologie (uniquement acquitté s'il est pris en charge par le maître, sinon ignoré par l'esclave)

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5.5.4 Transitions du diagramme d'états HP

Les transitions du diagramme d'états HP sont décrites dans le Tableau 74.

Tableau 74 – Transitions du diagramme d'états HP

Transition		Condition	Description
Source	Cible		
état NRT	HP0	HPSwitch(HP0)	Si un esclave est connecté dans les phases CPI à CP4 et reconnaît un MST de CP4 et l'esclave prend en charge la connexion à chaud, il commute alors sur la phase 0 de connexion à chaud (HP0) et évalue le champ de connexion à chaud de MDT0. Si le dernier esclave dans une topologie linéaire signale une liaison dans l'état S-DEV.Topology & Port au niveau de son port inactif, le maître reconnaît alors un appareil supplémentaire connecté (appareil esclave ou Ethernet) et doit activer la procédure de connexion à chaud en définissant la commande HP, bit 15 à 1.
HP0	HP1	HPSwitch(HP1)	Si l'esclave HP a reçu et vérifié tous les paramètres HP0 sans erreur, l'esclave HP doit alors commuter sur HP1 et changer l'état de topologie à celui de bouclage avec acheminement. Il faut que ceci ait lieu au niveau du port sur lequel l'esclave HP a reçu les paramètres HP0. Si le dernier esclave dans la topologie linéaire signale une liaison de Type 19 dans l'état S-DEV.Topology & Port au niveau de son port inactif, le maître doit alors commuter sur HP 1.
HP1	HP2	HPSwitch(HP2)	Si tous les esclaves HP d'un appareil HP ont reçu et vérifié tous les paramètres HP1 sans erreur, le maître doit alors commuter sur HP2. Pour cela le maître doit définir bit 8=1 dans la commande HP et MHS=1 dans la commande SVC associée. Après cela, l'esclave HP doit définir AHS=1 et SVC valide =1 dans l'état SVC de la SVC attribuée dans l'AT. Si une erreur survient dans l'esclave HP pendant la commutation sur HP2 par exemple, paramètres erronés), il génère alors un message d'erreur dans la commande HP (bit 8=1 et code d'erreur = 2). Dans ce cas le maître doit préparer la commutation sur HP0 Le maître et l'esclave HP doivent activer HP2 si aucune erreur ne survient.
HP2	CP4	HPSwitch(CP4)	Le maître doit inciter l'appareil HP à quitter la phase HP2 à l'aide du Contrôle de transition CP4 (S-0-0128) pour son commutation sur CP4. L'appareil HP doit traiter la commande de procédure tel qu'il est décrit en CP3. L'esclave HP active CP4 lorsqu'il génère un acquittement positif du Contrôle de transition CP4 (S-0-0128) et le bit d'Esclave valide est réglé sur 1 dans l'état d'appareil.
HP1..HP2	HP0	HPenable == 0 (HP actif)	Cas 1, HP1: Lorsque le maître n'obtient pas de réponse de l'esclave HP analysé dans cette durée définie, le maître doit interrompre la procédure de connexion à chaud avec un message d'erreur et doit préparer la commutation sur HP0. Cas 2, HP1: Si le transfert d'un paramètre HP1 d'un esclave HP de l'appareil HP est acquitté avec erreur, le maître doit alors interrompre la procédure de connexion à chaud avec un message d'erreur et doit préparer la commutation sur HP0. Les acquittements avec erreur éventuelle d'un esclave HP sont présentés dans le Tableau 75. Cas 3, HP2: Si une erreur survient dans l'esclave HP pendant la phase HP2 et le maître n'est pas en mesure de détecter cette erreur, le maître doit alors préparer la commutation sur HP0. Préparation de la commutation sur HP0: Avant que le maître ne commute sur HP0, il doit activer l'état '' bouclage avec acheminement'' au niveau du dernier esclave en ligne et attend le changement de topologie du dernier esclave. A l'issue de cela, le

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Transition		Condition	Description
Source	Cible		
			maître doit définir la commande HP, bit 9 à 0 et commute sur HP0.
Connexion à chaud	Etat NRT	HPsupported==0 (HP pris en charge)	L'esclave HP doit commuter de chaque phase HP sur l'état NRT avec l'une des conditions suivantes: Si l'esclave ne reçoit pas un MST dans un délai de 130 ms. Si le maître ne prend pas en charge la connexion à chaud en définissant la commande HP, bit 15 à 0.
Connexion à chaud	CP0	MST.Phase.CP == CP0	L'esclave HP doit commuter sur CP0 si l'esclave HP reçoit un MST avec CP = CP0

Tableau 75 – Champ de connexion à chaud AT en HP1 (Erreur)

Adresse HP AT	Etat HP	INFO HP AT	Acquittement de
adresse d'appareil de l'esclave	0x0180	sans importance ('don't care')	Décalage SVC MDT
adresse d'appareil de l'esclave	0x0181	sans importance ('don't care')	Décalage SVC AT
adresse d'appareil de l'esclave	0x0182	sans importance ('don't care')	Index de topologie (uniquement si pris en charge, sinon il est ignoré)

5.6 Procédures d'état

Le mot d'état d'appareil spécifié est renvoyé à l'utilisateur DL sur une demande Get_Device_Status (GDS) de ce dernier dans l'appareil maître.

Le mot de commande de l'appareil spécifié est défini sur une demande Set_Device_Status (GDS) de l'utilisateur DL dans l'appareil maître.

L'état du réseau est renvoyé à l'utilisateur DL sur une demande Get_Network_Status (GNS) de ce dernier dans l'appareil maître.

6 Méthodes de transmission de données

6.1 Présentation générale

Les méthodes de transmission de données représentent les moyens par lesquels une DLE réalise ses fonctions et affecte le comportement du protocole DL. Les méthodes sont initiées, exécutées et achevées sous le contrôle des services sollicités, comme cela est spécifié dans le service DL de Type 19.

6.2 Voie de service (SVC)

6.2.1 Traitement SVC

Les données acycliques sont échangées entre un appareil maître et un appareil esclave sur une demande Lecture (RD) initiée par l'utilisateur DL dans un appareil maître. Pour transmettre ces données, le champ INFO SVC doit être réservé pour la voie de service dans le MDT (voir 4.5.7.3.3) et dans l'AT (voir 4.6.7.3.3). Des bits spéciaux dans la commande SVC MDT et l'état SVC AT doivent permettre de commander l'exécution dans la voie de

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service. De ce fait, le maître doit être capable de prendre en charge une voie de service distincte pour chaque appareil esclave utilisé.

Pendant une transmission SVC, les opérations suivantes doivent être possibles:

- initialisation de la communication de Type 19;
- transmission de tous les éléments de blocs de données d'un paramètre;
- transmission des commandes de procédure;
- changement des valeurs limites sur demande;
- changement des paramètres de boucle de commande sur demande;
- obtention de télégrammes d'état détaillés provenant d'un appareil esclave;
- fonctions de diagnostic.

Toute transmission SVC doit toujours être initiée et commandée par le maître. Les actions, “lire élément de bloc de données” ou “écrire élément de bloc de données”, doivent être du ressort du maître. Toutes les actions doivent toujours être liées au dernier IDN transmis.

La transmission SVC de paramètre ou d'une commande de procédure doit être traitée par l'intermédiaire d'une séquence opérationnelle prédéterminée (voir Figure 32) relative à des actions individuelles. Le maître doit observer strictement le profil de ces diagrammes.

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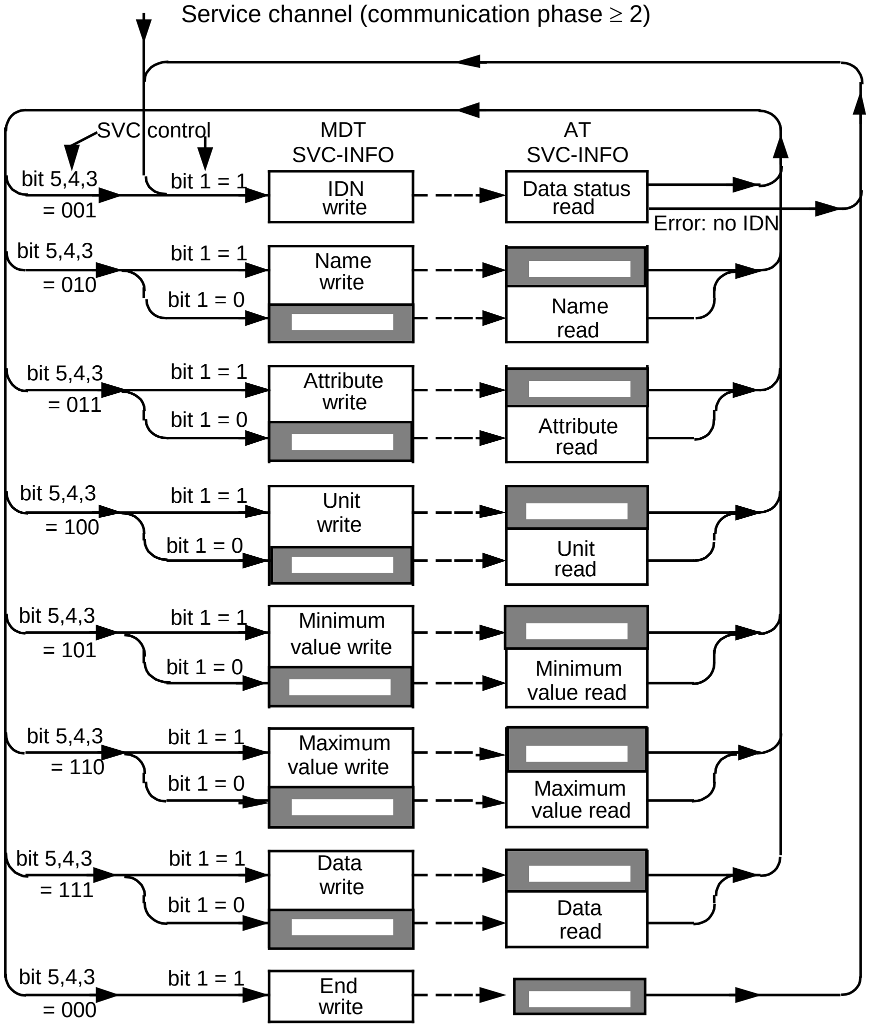

Légende

Anglais	Français
Service channel	Voie de service
Communication phase	Phase de communication
SVC control	Commande SVC
IDN write	Ecriture IDN
Data status read	Lecture état de données
Error: no IDN	Erreur: pas de IDN
Name write	Ecriture Nom
Name read	Lecture Nom
Attribute write	Ecriture Attribut
Attribute read	Lecture Attribut
Unit write	Ecriture Unité
Unit read	Lecture Unité
Minimum value write	Ecriture valeur minimale
Minimum value read	Lecture valeur minimale
Maximum value write	Ecriture valeur maximale
Maximum value read	Lecture valeur maximale
Data write	Ecriture Données
Data read	Lecture Données
End write	Fin écriture

Figure 32 – Diagramme de traitement de la voie de service

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6.2.2 Ouverture et fermeture de SVC

- Ouverture de SVC: Le maître doit ouvrir la SVC par la transmission de l'IDN du paramètre (commande SVC, bits 5, 4, 3 = 001, élément 1). Chaque accès aux éléments de blocs de données 2-7 se rapporte au dernier IDN transmis. L'esclave doit répondre en transmettant l'état de données ou l'acquittement de la commande de procédure de l'IDN reçu.
- Fermeture de SVC: La SVC de l'IDN précédent doit être fermée par l'ouverture de la SVC pour un nouvel IDN. Le cas échéant, le maître peut fermer la SVC en transmettant l'élément de bloc de données 0 (commande SVC, bits 5, 4, 3 = 000, élément 0).

6.2.3 Sélection de l'élément de bloc de données

Au cours de l'étape suivante, le maître doit indiquer les éléments du bloc de données qui doivent être traités. A cette fin, le maître doit régler les bits 5, 4 et 3 en conséquence dans la commande SVC.

6.2.4 Changement de l'élément de bloc de données

Le changement de l'élément du bloc de données lors de la transmission en cours ne doit être possible, et ce sans avoir de message d'erreur, que lorsque les bits suivants ont l'état donné à la Figure 33.

Tableau 76 – Condition de modification des éléments de blocs de données

Information	bit de commande SVC	bit d'état SVC	valeur de bit
Bits de protocole équivalents	bit 0	bit 0	MHS = AHS
Occupé		bit 1	0
SVC valide		bit 3	1

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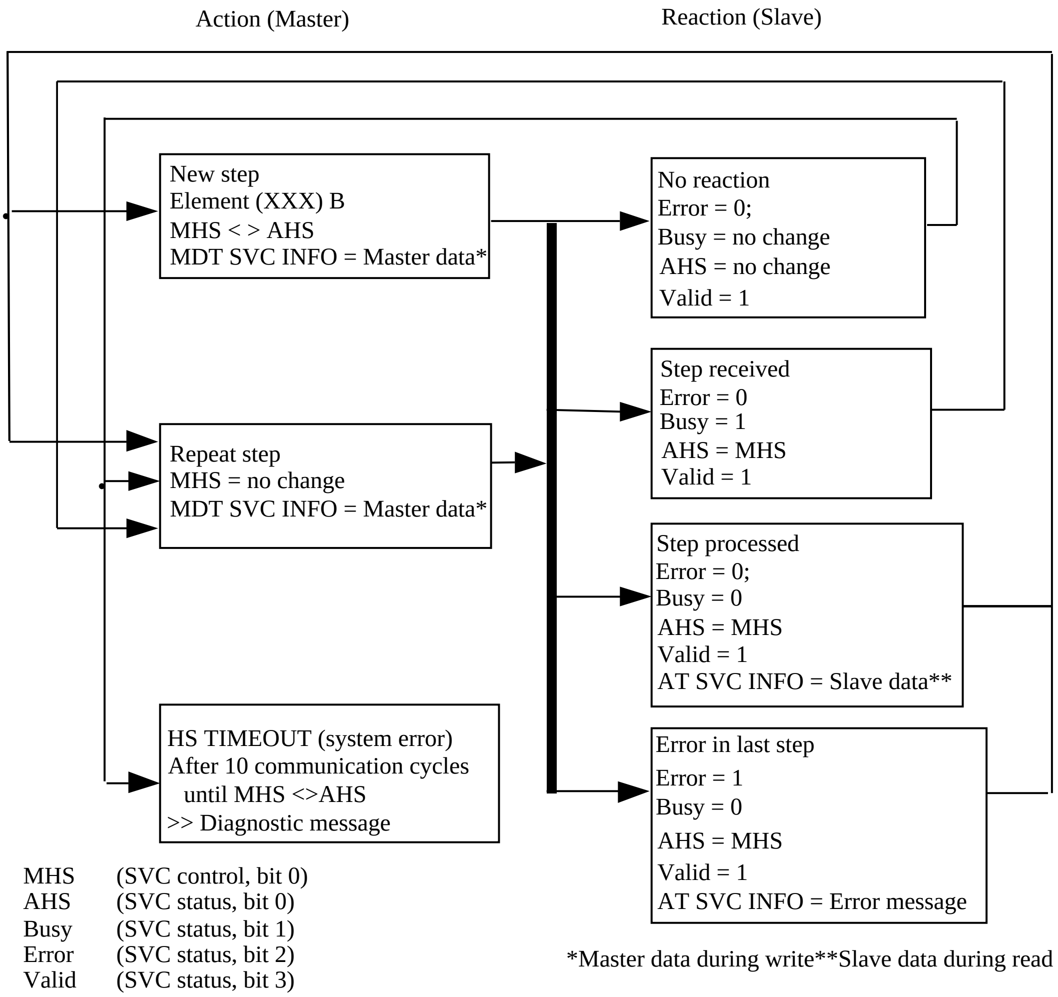

Légende

Anglais	Français
Action (Master)	Action (Maître)
Reaction (Slave)	Réaction (Esclave)
New step	Nouvelle étape
Master data	Données de maître
No reaction	Pas de réaction
Error	Erreur
Busy	Occupé
no change	pas de changement
Valid	Valide
Step received	Etape reçue
Repeat step	Répétition étape
Step processed	Etape traitée
Slave data	Données d'esclave
HS TIMEOUT	TEMPORISATION HS
System error	Erreur système
After 10 communication cycle until MHS <> AHS	Après 10 cycles de communication jusqu'à ce que MHS <> AHS
Diagnostic message	Message de diagnostic
Error in last step	Erreur dans la dernière étape

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Anglais	Français
Error message	Message d'erreur
SVC control	Commande SVC
SVC status	Etat SVC
Master data during write	Données de maître en cours d'écriture
Slave data during read	Données d'esclave en lecture

Figure 33 – Diagramme de traitement des étapes de communication

6.2.5 Etapes de transmission

Selon la longueur des éléments de blocs de données devant être transmis, et selon la longueur du champ INFO SVC, plusieurs étapes doivent être exécutées. Chaque étape doit acheminer quatre octets de données.

Le Tableau 77 présente les étapes nécessaires pour chaque élément de blocs de données d'un paramètre.

Tableau 77 – Liste des éléments de blocs de données et nombre d'étapes

Elément de bloc de données	Description	Exigence	Nombre d'étapes	
1	IDN	Obligatoire	1	
2	Nom	Facultatif	1 à 64	
3	Attribut	Obligatoire	1	
4	Unité	Facultatif	1 à 16	
5	Valeur minimale	Facultatif	1 ou 2	
6	Valeur maximale	Facultatif	1 ou 2	
7	Données d'exploitation	Obligatoire	Longueur fixe:	1 ou 2
			Longueur variable:	1 à 16 384
0	**Fermeture** de la voie de service		1	

Les messages d'erreur "transmission des éléments de bloc de données trop longue" doivent être exécutés par l'esclave si l'élément de bloc de données actuel est transmis entièrement et si le maître indique que la transmission est en cours (commande SVC, bit 2 = 0).

Les messages d'erreur "transmission des éléments de bloc de données trop courte" doivent être exécutés par l'esclave si l'élément de bloc de données actuel n'est pas transmis entièrement et si le maître indique la dernière transmission (commande SVC, bit 2 = 1).

Le maître doit indiquer une transmission en cours (commande SVC, bit 2 = 0), une transmission en cours (bit 2 = 0), ou la transmission des 4 derniers octets (commande SVC, bit 2 = 1). Une seule étape est requise si la longueur de l'élément de bloc de données est ≤ 4 octets. Dans ce cas, le maître doit régler la dernière transmission (commande SVC, bit 2 = 1).

Accès à un IDN de longueur variable sans données d'exploitation (élément de bloc de données = 4 octets):

- Le maître ne connaît pas la longueur de l'élément de bloc de données et règle la transmission en cours (commande SVC, bit 2 = 0).
- Par conséquent, l'esclave génère le message d'erreur "transmission des éléments de blocs de données trop longue".

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- Le maître peut lire le même élément de bloc de données avec la dernière transmission (commande SVC, bit 2 = 1) pour obtenir l'indication des longueurs de 4 octets.

6.2.6 SVC valide

Le maître et l'esclave doivent lire les informations SVC dans chaque cycle, sur le port 1 ou le port 2, selon la topologie. En cas d'échec un port, ils doivent lire ces informations automatiquement sur l'autre port.

Le maître et l'esclave doivent toujours écrire des informations SVC identiques sur les deux ports.

Le maître doit évaluer la réponse SVC de l'esclave uniquement s'il lit “SVC valide” = 1 (état SVC, bit 3). Il ne doit pas l'évaluer si “SVC valide” = 0 (invalide).

Le SVC valide est réglé sur 1 par l'esclave en CP1.

6.2.7 Bits de protocole

Lors des transmissions SVC, la transmission de chaque étape doit être protégée par deux bits de protocole de transport. Ces derniers doivent être les bits 0 de la commande SVC (MHS) et de l'état SVC.

Pour chaque nouvelle étape pendant la transmission, le maître doit commuter le bit MHS. L'esclave doit reconnaître, par le bit MHS basculé, qu'une nouvelle étape doit être exécutée. Une fois que l'esclave a reçu l'étape requise et qu'il en a protégé le traitement, il doit régler son bit AHS pour qu'il corresponde au bit MHS. En comparant le bit MHS et le bit AHS, le maître et les esclaves doivent toujours être capables de reconnaître l'état réel de la transmission pendant une transmission SVC (voir Tableau 78).

Tableau 78 – Evaluation de la voie SVC

Perspective	Condition	Description
Maître	bit AHS = bit MHS (SVC valide = 1)	L'étape a été reçue par l'esclave qui l'a protégée, l'esclave commence le traitement. Le maître doit attendre l'acquittement du traitement (occupé = 0, bit 1 dans l'état SVC).
	bit AHS ≠ bit MHS ou SVC valide = 0	Les étapes n'ont pas encore été reçues ou protégées par l'esclave. Le maître doit répéter la dernière étape
Esclave	bit MHS = bit AHS	Le maître n'exige pas une nouvelle étape, l'esclave répète la dernière étape.
	Bit MHS du maître ≠ bit AHS de l'esclave	Le maître exige une nouvelle étape

Les bits de protocole de transport doivent permettre aux esclaves et au maître d'intégrer des “cycles d'attente” pendant la transmission, par exemple:

- si deux cycles ou plus sont requis pour la réception ou la transmission d'une étape;
- si une nouvelle étape n'a pas été reconnue en raison d'une erreur de transmission;
- si le maître ne génère pas de nouvelles étapes à cet instant.

Pendant chaque “cycle d'attente”, le maître ou l'esclave doit transmettre les données du cycle de communication précédent dans le champ INFO SVC.

L'esclave doit acquitter la bonne réception d'une étape en adaptant son bit AHS dans le cadre de 10 cycles de communication au maximum.

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6.2.8 Lecture/Ecriture

Le maître doit indiquer dans le bit 1 de la commande SVC si l'élément sera lu ou écrit. Pendant l'écriture, le champ INFO SVC MDT doit être rempli avec les données appropriées pour l'esclave (le contenu du champ INFO SVC AT n'est pas valide).

Lorsque la lecture est sélectionnée, l'esclave doit intégrer les données appropriées dans le champ INFO SVC AT (le contenu du champ INFO SVC MDT n'est pas valide).

6.2.9 Bit occupé

L'esclave doit être capable de contrôler toute transmission SVC par l'intermédiaire du bit occupé. Ce dernier doit indiquer que l'esclave est en train de traiter l'étape requise à cet instant, ou qu'il est juste en train d'en terminer le traitement. Le maître ne doit pas être autorisé à lancer l'étape suivante tant que l'esclave n'a pas envoyé l'acquittement de traitement (bit occupé = 0). Le bit occupé doit permettre à l'esclave d'empêcher le maître de forcer trop rapidement l'esclave à traiter les étapes.

Une durée maximale n'est pas spécifiée si le bit occupé = 1. Le temps d'arrêt maximal acceptable et la réaction du maître sont liés à l'application.

6.2.10 Initialisation de la voie de service

La voie de service doit être initialisée au cours de CP1 et être fonctionnelle pour le reste des phases de communication.

En phase CP1, chaque voie de service doit débuter avec l'état suivant:

- le maître doit régler le bit MHS sur 1 dans le mot de commande SVC MDT,
- l'esclave doit régler "SVC valide" et AHS sur 1 dans le mot d'état SVC AT, si le maître l'a demandé en CP1,
- tous les autres bits de la commande SVC ou de l'état SVC doivent être réglés sur 0,
- tous les bits des champs INFO SVC sont invalides.

En commençant avec la phase CP2, les champs SVC MDT (commande et INFO) et SVC AT (état et INFO) deviennent valides.

Lors de la commutation de phase, l'état de MHS et AHS doit être enregistré dans le maître et les esclaves. L'état enregistré doit être rétabli dans la phase CP suivante.

6.2.11 Réaction à la temporisation de protocole SVC

Une temporisation de protocole (HS) doit se produire si tout esclave adressé n'acquitte pas son bit AHS dans le mot d'état après 10 cycles de communication dans les phases CP2 à CP4. Au cours de CP1, un esclave doit être enregistré comme absent si le bit AHS n'a pas été réglé sur 1 logique pendant la durée d'identification maximale du maître (voir Tableau 79).

Tableau 79 – Réaction à la temporisation de protocole

CP	Réaction du maître	Réaction de l'esclave
2-4	Affichage d'un message d'erreur. Le maître répond par une procédure de traitement des erreurs susceptible d'être archivée dans l'unité de commande, et qui peut ensuite recommuter sur CP0.	

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6.2.12 Réaction aux messages d'erreur dans la voie de service

Un message d'erreur valide pour le maître est présent dans la voie de service si l'esclave règle le bit 2 dans l'état SVC sur 1 et si le bit AHS de l'esclave est égal au bit MHS de la commande SVC (voir Tableau 80).

Tableau 80 – Réaction à un message d'erreur

CP	Réaction du maître	Réaction de l'esclave
2-4	Affichage d'un message d'erreur	L'étape en cours de traitement est interrompue, le bit occupé (bit 1 - état SVC) est réglé sur "0".

6.2.13 Messages d'erreur dans la voie de service

En cas d'erreur dans le mécanisme de transport de la voie de service (par exemple, si les longueurs des données d'exploitation diffèrent entre le maître et l'esclave, ou inversement, ou si l'IDN n'est pas défini), l'esclave doit l'annoncer en réglant le bit d'erreur (bit 2) dans le mot d'état et en saisissant un code d'erreur dans le champ INFO de service de son AT.

L'esclave doit être autorisé à signaler un message d'erreur uniquement si le maître génère une nouvelle étape de traitement, qui relève de l'un des cas suivants:

- bit MHS ≠ bit AHS (étape non encore protégée);
- bit occupé = 1 (étape toujours en cours).

Si l'esclave reconnaît une erreur, il doit ignorer l'étape réelle, l'interrompre et l'acquitter en:

- réglant le bit AHS sur le bit MHS (si non déjà acquitté dans un cycle précédent);
- réglant le bit d'erreur sur 1 (état SVC, bit 2);
- réglant le bit occupé sur 0;
- réglant le SVC valide sur 1;
- envoyant les codes d'erreur dans le champ INFO SVC AT (voir 4.6.7.3.3).

Si le maître envisage de lancer une transmission d'un élément après un message d'erreur, l'esclave doit actualiser l'état SVC et le champ INFO SVC AT.

Tous les messages d'erreur SVC potentiels sont présentés dans le Tableau 81.

Tableau 81 – Messages d'erreur

Code d'erreur	Description
0x0nnn	Erreur générale
0x0000	Aucune erreur dans la voie de service
0x0001	Voie de service non ouverte
0x0009	Accès invalide à la fermeture de la voie de service
0x1nnn	Elément 1 (numéro d'identification)
0x1001	IDN non disponible
0x1009	Accès à l'élément 1 invalide
0x2nnn	Elément 2 (Nom)
0x2001	Nom non disponible
0x2002	Transmission de nom trop courte
0x2003	Transmission de nom trop longue

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Code d'erreur	Description
0x2004	Changement de nom impossible (lecture seulement)
0x2005	Nom protégé en écriture, à cet instant
0x3nnn	Elément 3 (Attribut)
0x3002	Transmission d'attribut trop courte
0x3003	Transmission d'attribut trop longue
0x3004	Changement d'attribut impossible (lecture seulement)
0x3005	Attribut protégé en écriture, à cet instant
0x4nnn	Elément 4 (Unité)
0x4001	Unité non disponible
0x4002	Transmission d'unité trop courte
0x4003	Transmission d'unité trop longue
0x4004	Changement d'unité impossible (lecture seulement)
0x4005	Unité protégée en écriture, à cet instant
0x5nnn	Elément 5 (valeur d'entrée minimale)
0x5001	Valeur d'entrée minimale non disponible
0x5002	Transmission de valeur d'entrée minimale trop courte
0x5003	Transmission de valeur d'entrée minimale trop longue
0x5004	Changement de valeur d'entrée minimale impossible (lecture seulement)
0x5005	Valeur d'entrée minimale protégée en écriture à cet instant
0x6nnn	Elément 6 (valeur d'entrée minimale)
0x6001	Valeur d'entrée maximale non disponible
0x6002	Transmission de valeur d'entrée maximale trop courte
0x6003	Transmission de valeur d'entrée maximale trop longue
0x6004	Changement de valeur d'entrée maximale impossible (lecture seulement)
0x6005	Valeur d'entrée maximale protégée en écriture à cet instant
0x7nnn	Elément 7 (Données d'exploitation)
0x7002	Transmission de données d'exploitation trop courte
0x7003	Transmission de données d'exploitation trop longue
0x7004	Changement de données d'exploitation impossible (lecture seulement)
0x7005	Données d'exploitation protégées en écriture à cette phase de communication
0x7006	Données d'exploitation inférieures à la valeur d'entrée minimale
0x7007	Données d'exploitation supérieures à la valeur d'entrée maximale
0x7008	Données d'exploitation invalides: IDN configuré non pris en charge, numéro de bit combinaison de bits invalide
0x7009	Données d'exploitation protégées en écriture par un mot de passe
0x700A	Données d'exploitation protégées en écriture, avec configuration cyclique. (IDN configuré dans le MDT ou l'AT. L'écriture via la voie de service n'est par conséquent pas admise).
0x700B	Adressage indirect invalide: (par exemple, conteneur de données, traitement de listes)
0x700C	Données d'exploitation protégées en écriture, en raison d'autres paramètres. (par exemple, mode de fonctionnement, activation du sous-appareil, etc.)
0x700D	virgule flottante invalide
0x700E	Données d'exploitation protégées en écriture au niveau du paramétrage
0x700F	Données d'exploitation protégées au niveau de fonctionnement
0x7010	Commande de procédure déjà active
0x7011	commande de procédure non interruptible

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Code d'erreur	Description
0x7012	Commande de procédure non exécutable à cet instant (par exemple, dans cette phase, la commande de procédure ne peut pas être activée).
0x7013	Commande de procédure non exécutable (paramètres invalides ou erronés)
0x7014	La longueur actuelle de la liste de paramètre reçue ne répond pas aux attentes
0x71n	Accès SVC segmenté pour les paramètres de longueur variable
0x7101	IDN dans S-0-0394 non valide
0x7102	Liste vide dans S-0-0397 non admis pour l'accès en écriture
0x7103	Longueur maximale de la liste dans S -0-0394 dépassée par la prise en charge du segment de liste.
0x7104	Accès en lecture seule: La longueur du segment de liste, tout comme celle de l'index de liste, dépasse la longueur actuelle de la liste dans S -0-0394.
0x7105	IDN dans S-0-0394 protégé en écriture
0x7106	Données d'exploitation dans le segment de liste inférieures à la valeur d'entrée minimale
0x7107	Données d'exploitation dans le segment de liste supérieures à la valeur d'entrée maximale
0x7108	index de liste invalide dans S-0-0395
0x7109	Le paramètre dans IDN S-0-0394 n'a pas de longueur variable
0x710A	IDN S-0-0397 non admis comme données d'exploitation dans S-0-0394
0x8nnn	(réservé pour les codes d'erreur internes du maître)
0xAnnn	(réservé)
0xBnnn	(réservé)
0xCnnn	(réservé)
0xDnnn	Les codes d'erreur ne sont pas générés et transmis via la SVC
0xD000	pas d'erreur
0xD001	voie de service (provisoirement) non disponible
0xD002	voie de service engagée par une application
0xD003	voie de service occupée, demande précédente traitée par l'esclave
0xD004	Esclave de Type 19 non accessible
0xD005	transaction de la voie de service annulée
0xD006	la voie de service ne prend pas en charge l'écriture de cet élément
0xEnnn	(réservé pour les codes d'erreur internes du maître)
0xFnnn	(réservé pour les codes d'erreur internes du maître)
Tous les autres codes doivent être réservés.	

6.2.14 Fonctions de commande de procédure via la voie de service

6.2.14.1 Généralités

Les fonctions de commande de procédure doivent être transmissibles au moyen de la voie de service. Une commande de procédure est considérée comme un type spécial de données non-cycliques qui invoquent des processus fonctionnels fixes dans les esclaves et le maître. Ces processus peuvent prendre du temps. Ainsi, une commande de procédure ne doit provoquer que le démarrage d'un processus fonctionnel. Dès le démarrage de la fonction d'une commande de procédure, la voie de service doit redevenir immédiatement disponible pour la transmission des données non-cycliques ou pour davantage de commandes de procédure.

Contrairement à la transmission des données non-cycliques, dont le traitement doit être achevé avec la dernière étape de transmission, la fin d'une commande de procédure au cours d'une exécution de longue durée de la commande de procédure doit être indiquée par le bit

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de changement de la commande de procédure (bit 5 dans l'état d'appareil). Le maître doit être également en mesure d'interrompre une commande de procédure pendant son exécution.

Il doit être attribué à chaque commande de procédure un IDN. Tous les éléments de bloc de données du paramètre ne sont cependant pas définis, et d'autres éléments de bloc de données doivent avoir une forme prédéterminée. Certaines commandes de procédure ne sont pas interruptibles.

6.2.14.2 Contrôle et acquittement de la commande de procédure

Une fonction de procédure de la commande doit toujours solliciter un contrôle de la commande de procédure du maître vers l'esclave et un acquittement de la commande de procédure d'un esclave au maître. Le contrôle de la commande de procédure doit être l'élément 7 du bloc de données du paramètre (l'élément 7 du bloc de données est toujours représenté comme une chaîne de bits relative à des commandes de procédure). voir Tableau 82.

Le contrôle de la commande de procédure doit permettre aux commandes de procédure d'être:

- réglées;
- activées pour exécution;
- interrompues pendant l'exécution;
- annulées.

L'esclave doit acquitter la transmission d'une commande de procédure provenant du maître par l'intermédiaire de la voie de service, avec son bit AHS, le bit occupé et le SVC valide dans son état SVC.

Tableau 82 – Structure du contrôle de la commande de procédure

Numéro de bit	Valeur	Description
15-2		(réservé)
1-0		Contrôle de la commande de procédure (PCC)
	00	commande de procédure n'est pas activée ou est annulée
	01	commande de procédure réglée et interrompue
	10	commande de procédure annulée
	11	commande de procédure réglée et activée

Lors du lancement de l'initialisation (CP0), toutes les commandes de procédure internes au maître doivent être annulées, puis le contrôle de la commande de procédure doit être actualisé de manière appropriée à l'intérieur du maître.

L'acquittement de la commande de procédure doit faire partie de l'état des données (voir Tableau 83).

Afin de recevoir un acquittement de la commande de procédure, le maître doit saisir l'IDN de la commande de procédure par l'intermédiaire de la voie de service.

Lors de l'acquittement d'une commande de procédure, l'esclave doit indiquer l'état actuel de la commande de procédure tel qu'indiqué dans le Tableau 83.

Si le maître active une commande de procédure, la génération de l'acquittement de la commande de procédure correspondant par l'esclave peut nécessiter plusieurs cycles de

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communication. Il est par conséquent recommandé que le maître analyse l'acquittement de la commande de procédure, comme cela est indiqué dans le Tableau 83.

Tableau 83 – Acquittement de la commande de procédure (état des données)

Numéro de bit	Valeur	Description
15-9		(réservé)
8		Données valides
	0	Données d'exploitation valides
	1	Données d'exploitation non valides
7-4		(réservé)
3-0		Acquittement de la commande de procédure (PCA)
	1111	erreur: exécution de la commande de procédure impossible (réglage du bit de changement de la commande de procédure)
	0111	commande de procédure activée mais non encore exécutée
	0101	interruption de l'exécution de la commande de procédure
	0011	Exécution correcte de la commande de procédure (réglage du bit de changement de la commande de procédure)
	0001	réglage de la commande de procédure
	0000	annulation de la commande de procédure
		Tous les autres codages sont réservés

Avec le lancement de l'initialisation (CP0), toutes les commandes de procédure internes à l'esclave doivent être désactivées, puis l'acquittement de la commande de procédure doit être actualisé de manière appropriée à l'intérieur de l'esclave.

6.2.14.3 Bit de changement de la commande de procédure

Afin d'informer le maître de la fin d'une commande de procédure en cours d'exécution dans l'esclave, le bit de changement de ladite commande est défini dans l'état d'appareil (bit 5).

Seuls les changements suivants dans l'acquittement de la commande de procédure (PCA) doivent établir le bit de changement de la commande de procédure:

- commande de procédure exécutée correctement (acquittement positif);
- erreur, exécution de la commande de procédure impossible (acquittement négatif).

Le bit de changement de la commande de procédure (PCB) ne doit indiquer aucun autre changement de l'acquittement de ladite commande (par exemple, une interruption).

Le maître doit lire l'état des données, en saisissant l'IDN de la commande de procédure, et doit également vérifier l'acquittement de ladite commande qui y est contenu. Cela indique si la commande de procédure a été exécutée positivement ou négativement.

Avec un acquittement de commande de procédure négatif, il est recommandé que le maître lise le diagnostic (lorsque souhaité) avant l'annulation de ladite commande.

Lorsqu'une commande de procédure est annulée par le maître, tous les effets de la commande de procédure sur le bit de changement de cette même commande dans l'esclave doivent être également annulés. Si le maître a simultanément activé plusieurs commandes de procédure, tous les acquittements de commande de procédure qui en résultent doivent être

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vérifiés après le réglage du bit de changement de la commande de procédure, afin de déterminer la commande qui a provoqué le changement.

En règle générale, le maître doit annuler une commande de procédure après son traitement, sans chercher à savoir si elle a été acquittée positivement ou négativement.

Une commande de procédure doit être annulée en réglant le bit 0 du contrôle de la commande de procédure sur 0. Ceci doit être indépendant de l'état d'exécution réel de la commande de procédure. Si l'esclave reconnaît l'annulation d'une commande de procédure, il doit régler l'acquittement de la commande de procédure sur 0 et régler simultanément le bit occupé sur 0.

Le diagramme d'états présenté à la Figure 34 définit les changements d'état admis pour les commandes de procédure.

Pour le contrôle de la commande de procédure (PCC), seules les valeurs de 0x00 à 0x03 sont admises. Si la valeur est non valide, l'esclave doit générer le message d'erreur "données d'exploitation non valides" (0x7008) dans le champ INFO SVC.

Un changement d'état sur “commande de procédure non définie" (PCA = 0x00) ne doit être possible que par annulation de la commande de procédure.

Lorsque plus d'une exécution de la commande de procédure est active et si le “bit de changement de la commande de procédure” (PCB) est réglé par plusieurs commandes de procédure, ce bit est remis dans l'état d'appareil lorsque toutes les commandes de procédure de réglage du bit ont été annulées.

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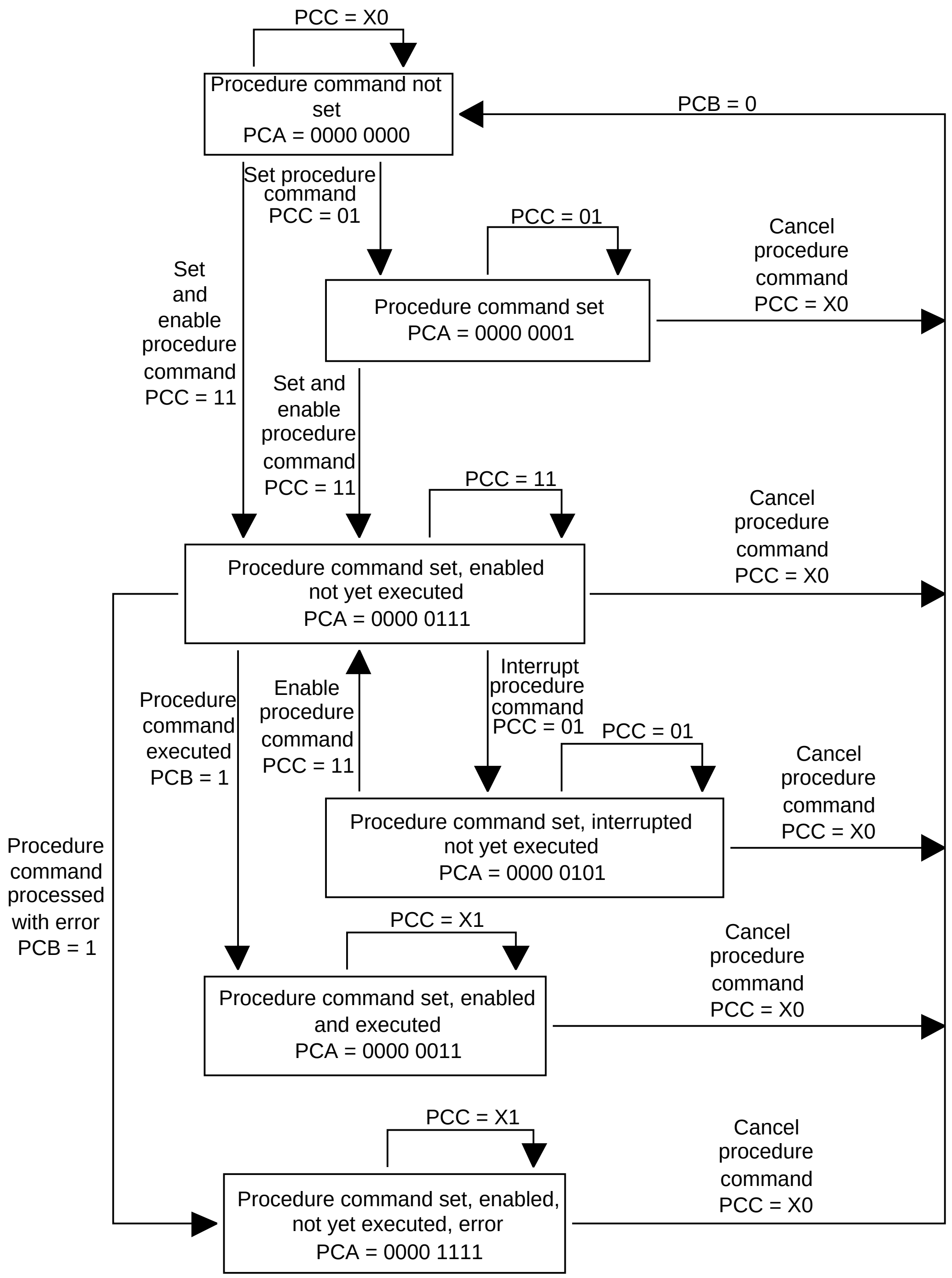

Légende

Anglais	Français
Procedure command not set	Commande de procédure non définie
Set procedure command	Définir commande de procédure
Set and enable procedure command	Définir et activer commande de procédure
Procedure command set	Procédure de commande définie
Cancel procedure command	Annuler commande de procédure
Procedure command set, enabled not yet executed	Commande de procédure définie, activée, non encore exécutée
Procedure command executed	Commande de procédure exécutée
Enable procedure command	Activer commande de procédure

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Anglais	Français
Interrupt procedure command	Interrompre commande de procédure
Procedure command set, interrupted not yet executed	Commande de procédure définie, interrompue, non encore exécutée
Procedure command processed with error	Commande de procédure traitée avec erreur
Procedure command set, enabled and executed	Commande de procédure définie, activée et exécutée
Procedure command set, enabled, not yet executed, error	Commande de procédure définie, activée, non encore exécutée, erreur

Figure 34 – Diagramme d'états pour l'exécution de la commande de procédure

La Figure 35 présente la séquence de traitement de la commande de procédure qui doit être respectée par le maître.

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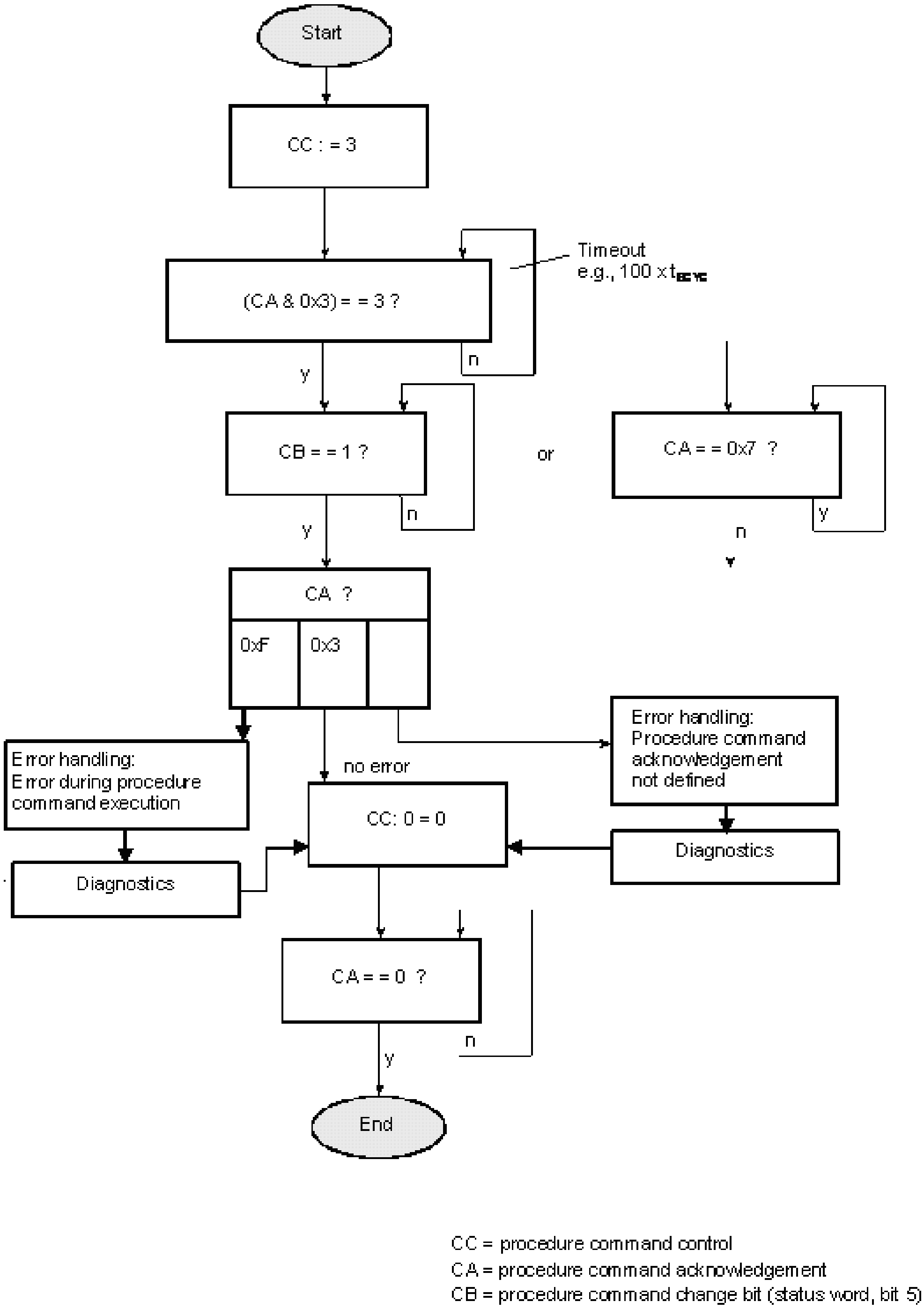

Légende

Anglais	Français
Start	Début
Timeout	Temporisation
Error handling	Traitement d'erreur
Error during procedure command execution	Erreur au cours de l'exécution de la commande de procédure
No error	Pas d'erreur
Procedure command acknowledgment not defined	Acquittement de commande de procédure non défini
Diagnostics	Diagnostics

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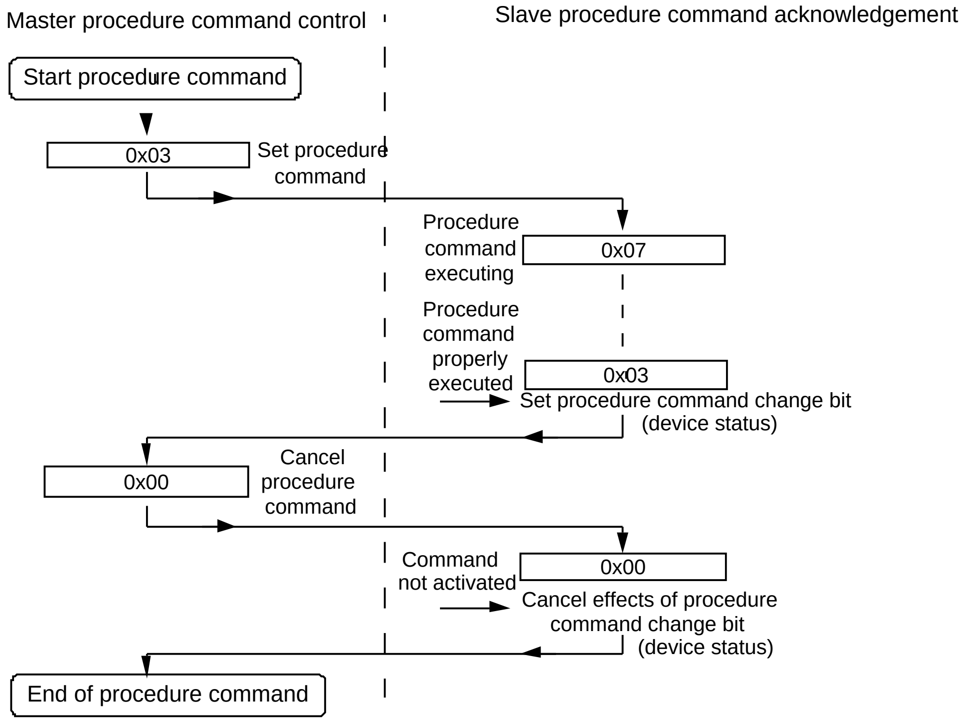
Anglais	Français
Procedure command control	Contrôle de commande de procédure
Procedure command acknowledgment	Acquittement de commande de procédure
Procedure command change bit (status word, bit 5)	Bit de changement de commande de procédure (mot d'état, bit 5)

Figure 35 – Interaction du contrôle et de l'acquittement de la commande de procédure

6.2.14.4 Exécution de la commande de procédure

La Figure 36, la Figure 37 et Figure 38 suivantes présentent les interactions entre le maître et l'esclave, y compris les exécutions de la commande de procédure avec ou sans interruption et les exécutions de la commande de procédure avec messages d'erreur.



Légende

Anglais	Français
Master procedure command control	Contrôle de commande de procédure de maître
Slave procedure command acknowledgment	Acquittement de commande de procédure d'esclave
Start procedure command	Début commande de procédure
Set procedure command	Définir commande de procédure
Procedure command executing	Exécution de commande de procédure
Procedure command property executed	Propriété de commande de procédure exécutée
Set procedure command change bit	Bit de changement de commande de procédure
Device status	Etat d'appareil
Cancel procedure command	Annuler commande de procédure
Command not activated	Commande non activée
Cancel effects of procedure command change bit	Annuler les effets du bit de changement de commande de procédure
End of procedure command	Fin de commande de procédure

Figure 36 – Exécution de la commande de procédure sans interruption

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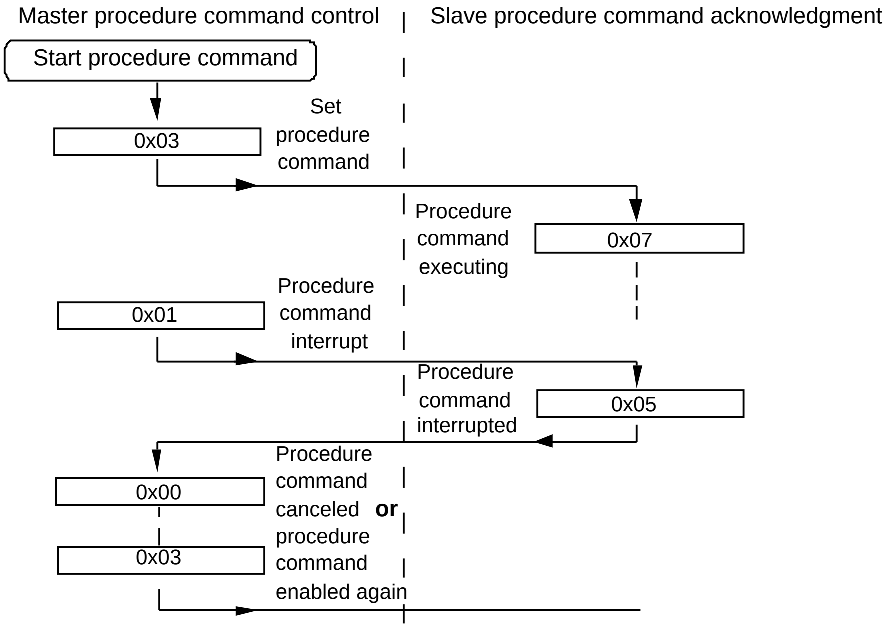

Légende

Anglais	Français
Master procedure command control	Contrôle de commande de procédure de maître
Slave procedure command acknowledgment	Acquittement de commande de procédure d'esclave
Start procedure command	Début commande de procédure
Set procedure command	Définir commande de procédure
Procedure command executing	Exécution de commande de procédure
Procedure command interrupt	Interruption commande de procédure
procedure command interrupted	commande de procédure interrompue
Procedure command canceled **or**	Commande de procédure annulée **ou**
procedure command enabled again	commande de procédure réactivée

Figure 37 – Exécution de la commande de procédure avec interruption

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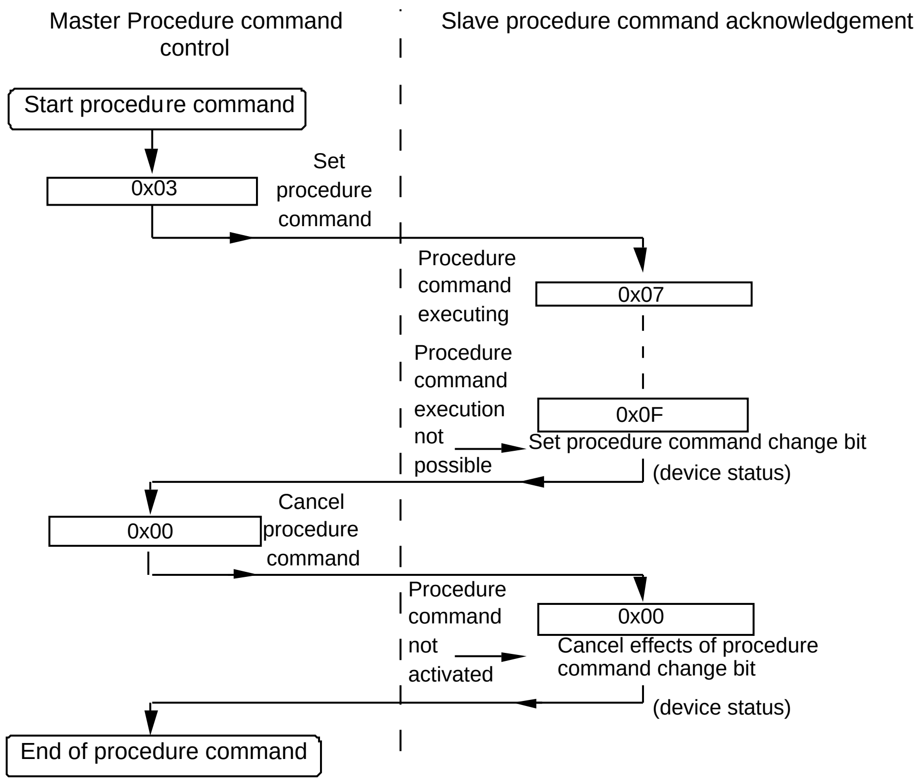

Légende

Anglais	Français
Master procedure command control	Contrôle de commande de procédure de maître
Slave procedure command acknowledgment	Acquittement de commande de procédure d'esclave
Start procedure command	Début commande de procédure
Set procedure command	Définir commande de procédure
Procedure command executing	Exécution de commande de procédure
Procedure command execution not possible	Exécution commande de procédure impossible
Set procedure command change bit	Définir bit de changement de commande de procédure
Device status	Etat d'appareil
Cancel procedure command	Annuler commande de procédure
Procedure command not activated	commande de procédure non activée
Cancel effects of procedure command change bit	Annuler les effets du bit de changement de commande de procédure
End of procedure command	Fin de commande de procédure

Figure 38 – Exécution de la commande de procédure avec message d'erreur

6.3 Canal RT

6.3.1 Introduction

Les données cycliques sont échangées entre tous les appareils d'un réseau de Type 19 dans la phase de communication CP4 selon la configuration donnée par la demande Initiate_cyclic_communication (voir 5.2).

6.3.2 Read_Cyclic (RDC)

La demande Read_Cyclic (RDC) permet à un utilisateur DL de lire les données cycliques.

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6.3.3 Write_Cyclic (WRC)

La demande Write_Cyclic (WRC) permet à un utilisateur DL d'écrire les données cycliques. Ces données sont transmises dans le cycle de communication suivant du réseau de Type 19.

6.3.4 Notify_Cyclic_Data (NCD)

Sur réception d'une DLPDU de type MDT0-MST, la DL génère une indication Notify_Cyclic_Data (NCD) à l'intention de l'utilisateur DL.

6.4 Transmission et activation de l'heure de Type 19

L'heure de Type 19 a une longueur de 8 octets et est transmise par fragments de 2 octets dans le champ étendu de MDT0. La fragmentation est contrôlée par 2 bits de commande (bits 31-30) dans le champ étendu, et le cycle CNT de MST. Le cycle CNT utilise les bits 6-4 dans la phase MDT et le bit 5 dans le type MDT. Chaque fragment de temps est transféré par Initiate_cyclic_communication reqd dans deux cycles de communication consécutifs, et le transfert tolère par conséquent une perte de télégramme. La séquence suivante doit être traitée par le maître:

- Cycle CNT = 0 et 1: les bits 0-15 de l'heure de Type 19 sont transmis en fragment de temps
- Cycle CNT = 2 et 3: les bits 16-31 de l'heure de Type 19 sont transmis en fragment de temps
- Cycle CNT = 4 et 5: les bits 32-47 de l'heure de Type 19 sont transmis en fragment de temps
- Cycle CNT = 6 et 7: les bits 48-63 de l'heure de Type 19 sont transmis en fragment de temps

L'esclave doit assembler tous les fragments de temps reçus dans l'heure de Type 19, en tenant compte des 2 bits de commande et du cycle CNT. Si un fragment de temps est invalide ou perdu, l'esclave doit alors rejeter tous les fragments de temps reçus. L'esclave doit attendre la transmission suivante de l'heure de Type 19.

Bit de commande – Fragment de temps valide

- Si le bit valide de fragment de temps est réglé sur 1, les données du champ "Fragments de temps" sont alors valides.
- L'esclave peut utiliser uniquement le fragment de temps, si ce bit est réglé sur 1.
- Le maître doit régler ce bit sur 1 uniquement, lorsque le cycle CNT de MST est égal à 0.
- Le maître peut régler le bit valide sur 0 à tout moment.

Bit de commande – Activation d'heure

- Dans un transfert continu de fragments de temps, ce bit est déclenché lorsque le maître a transmis une nouvelle heure
- Le maître doit déclencher ce bit uniquement, lorsque le cycle CNT de MST est égal à 0.
- L'esclave doit activer l'heure de Type 19 si ce bit s'est déclenché.

Calcul de la prévision de durée dans le maître

Le transfert et l'activation de l'heure de Type 19 prennent un certain retard, par conséquent, le maître transmet une prévision de durée à l'esclave. Le maître archive cette prévision de durée au début du cycle de communication uniquement si le cycle CNT de MST est égal à 0. La durée archivée est transmise aux esclaves (voir Figure 39).

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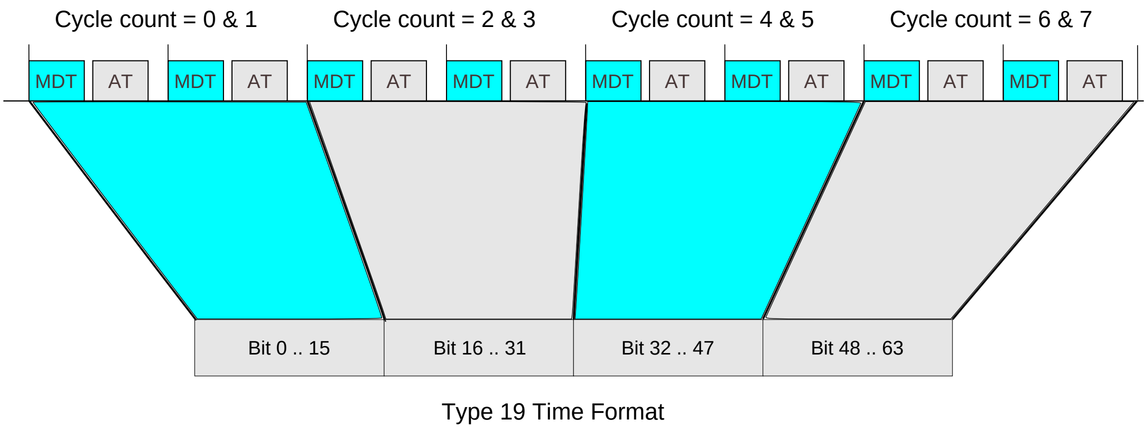
Dans les esclaves, l'activation de l'heure de Type 19 se produit au temps de référence de synchronisation (TSref). Pour cette raison, le maître doit ajouter le retard à TSref. La prévision de durée génère la formule suivante:

$$\text{TIME forecast} = \text{TIME current} + 8 \cdot t_{Scyc} + \text{Time delay}$$

Prévision DUREE = DUREE actuelle + $8.t_{Scyc}$ + Retard

NOTE Le retard est la durée comprise entre le début du cycle de communication dans le maître et la durée TSref interne à l'esclave.



Légende

Anglais	Français
Cycle count	Nombre de cycles
Type 19 Time Format	Format temporel de Type 19

Figure 39 – Transmission de l'heure de Type 19

6.5 Multiplexage des données en temps réel avec conteneurs de données

6.5.1 Généralités

Le multiplexage des paramètres offre des fonctions de communication supplémentaires.

Cela signifie:

a) que le transfert de paramètres différents au même emplacement du champ de données en temps réel est possible;

b) que le changement de configuration des télégrammes par une nouvelle initialisation de phase n'est pas nécessaire.

c) L'accès aux éléments de liste discrets utilise cette procédure.

Le multiplexage utilise:

a) des paramètres sous forme de conteneurs, pour la transmission de paramètres différents;

b) des paramètres sous forme de listes, pour l'énumération de tous les paramètres à transmettre;

c) des paramètres sous forme de pointeurs, pour l'adressage du paramètre qui sera transmis;

d) des paramètres sous forme d'index, pour l'adressage de l'élément de liste qui sera transmis en cas d'adressage d'un paramètre de liste;

Deux méthodes de multiplexage sont disponibles:

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a) Méthode standard (conteneur de données standard)

b) Méthode étendue (conteneur de données étendu)

Ce groupe de fonctions comprend les IDN suivants

- S-0-0360 Conteneur A1 de données MDT
- S-0-0361 Conteneur B1 de données MDT
- S-0-0362 Index de liste de conteneurs A de données MDT
- S-0-0363 Index de liste de conteneurs B de données MDT
- S-0-0364 Conteneur A1 de données AT
- S-0-0365 Conteneur B1 de données AT
- S-0-0366 Index de liste de conteneurs A de données AT
- S-0-0367 Index de liste de conteneurs B de données AT
- S-0-0368 Pointeur de conteneur A de données
- S-0-0369 Pointeur de conteneur B de données
- S-0-0370 Liste de configuration de conteneurs A&B de données MDT
- S-0-0371 Liste de configuration de conteneurs A&B de données AT
- S-0-0444 liste des IDN de données configurables dans le conteneur de données AT
- S-0-0445 liste des IDN de données configurables dans le conteneur de données MDT
- S-0-0450 Conteneur A2 de données MDT
- S-0-0451 Conteneur A3 de données MDT
- S-0-0452 Conteneur A4 de données MDT
- S-0-0453 Conteneur A5 de données MDT
- S-0-0454 Conteneur A6 de données MDT
- S-0-0455 Conteneur A7 de données MDT
- S-0-0456 Conteneur A8 de données MDT
- S-0-0457 Conteneur A9 de données MDT
- S-0-0458 conteneur A10 de données MDT0
- S-0-0459 Conteneur B2 de données MDT
- S-0-0480 Conteneur A2 de données AT
- S-0-0481 Conteneur A3 de données AT
- S-0-0482 Conteneur A4 de données AT
- S-0-0483 Conteneur A5 de données AT
- S-0-0484 Conteneur A6 de données AT

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- S-0-0485 Conteneur A7 de données AT
- S-0-0486 Conteneur A8 de données AT
- S-0-0487 Conteneur A9 de données AT
- S-0-0488 Conteneur A10 de données AT
- S-0-0489 Conteneur B2 de données AT
- S-0-0490 Liste de configuration de conteneurs A2 de données MDT
- S-0-0491 Liste de configuration de conteneurs A3 de données MDT
- S-0-0492 Liste de configuration de conteneurs A4 de données MDT
- S-0-0493 Liste de configuration de conteneurs A5 de données MDT
- S-0-0494 Liste de configuration de conteneurs A6 de données MDT
- S-0-0495 Liste de configuration de conteneurs A7 de données MDT
- S-0-0496 Liste de configuration de conteneurs A8 de données MDT
- S-0-0497 Liste de configuration de conteneurs A9 de données MDT
- S-0-0498 Liste de configuration de conteneurs A10 de données MDT
- S-0-0500 Liste de configuration de conteneurs A2 de données AT
- S-0-0501 Liste de configuration de conteneurs A3 de données AT
- S-0-0502 Liste de configuration de conteneurs A4 de données AT
- S-0-0503 Liste de configuration de conteneurs A5 de données AT
- S-0-0504 Liste de configuration de conteneurs A6 de données AT
- S-0-0505 Liste de configuration de conteneurs A7 de données AT
- S-0-0506 Liste de configuration de conteneurs A8 de données AT
- S-0-0507 Liste de configuration de conteneurs A9 de données AT
- S-0-0508 Liste de configuration de conteneurs A10 de données AT

6.5.2 Fonctionnalité du conteneur de données standard

6.5.2.1 Généralités

Les conteneurs de données standard proposent une commutation multiplexé entre différentes données en temps réel dans les télégrammes MDT et AT avec un mécanisme d'adressage distinct.

Les conteneurs de données standard doivent, pour pouvoir utiliser ce mécanisme, être configurés dans les télégrammes MDT et AT.

Les conteneurs de données standard permettent:

a) d'échanger un plus grand nombre de données d’application dans les télégrammes MDT et AT malgré la longueur limitée des connexions;
b) d'accéder aux éléments de liste discrets grâce aux paramètres d'index de liste des MDT et AT;
c) de transférer des données d’application multiplexées dans chaque cycle de communication avec une durée de cycle associée à un nombre tscyc * de paramètres de multiplexage par incrémentation de l'adressage.

Il existe 2 conteneurs de données avec une longueur de 4 octets et 2 conteneurs de données avec une longueur de 8 octets, définis pour MDT et AT.

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6.5.2.2 Conteneurs de données (standard)

Plusieurs conteneurs de données standard sont définis pour les MDT et AT, et utilisés comme paramètres fictifs. Le maître peut, si nécessaire, modifier le contenu des conteneurs de données de manière dynamique.

Le maître écrit les paramètres dans l'esclave au moyen des conteneurs de données MDT.

Le maître lit les paramètres en provenance de l'esclave au moyen des conteneurs de données AT.

Les "conteneurs de données standard" spécifiés sont énumérés ci-dessous:

- conteneur A1 de données MDT ou S-0-0360
- conteneur A9 de données MDT ou S-0-0457
- conteneur B1 de données MDT ou S-0-0361
- conteneur B2 de données MDT ou S-0-0459
- conteneur A1 de données AT ou S-0-0364
- conteneur A9 de données AT ou S-0-0487
- conteneur B1 de données AT ou S-0-0365
- conteneur B2 de données AT ou S-0-0489

Les combinaisons indiquées dans le Tableau 84 sont admises pour les "conteneurs de données MDT" et les "conteneurs de données AT".

Tableau 84 – Liste des combinaisons valides des conteneurs de données standard

Abréviation	Longueur (octets)
A1	4
A9	8
A1 + B1	4 + 4
A9 + B1	8 + 4
A1 + B2	4 + 8
A9 + B2	8 + 8

Comme on peut le voir:

a) Un "conteneur A de données" (A1 ou A9)" au maximum est admis;
b) Un "conteneur B de données" (B1 ou B2)" au maximum est admis, mais uniquement en complément de "conteneur A de données".

La combinaison "conteneur de données MDT" est indépendante de la combinaison "conteneur de données AT". Les conteneurs de données doivent être configurés en phase CP2 uniquement.

Lorsqu'un paramètre transmis est moins important que son conteneur de données, il doit être placé sur la partie inférieure du conteneur de données. Dans ce cas, la partie supérieure reste libre, et respectivement non valide.

6.5.2.3 Configuration du conteneur de données standard

a) Listes de configuration

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1) La liste de configuration des conteneurs A&B de données MDT ou S-0-0370 doit comporter tous les paramètres configurés des conteneurs de données MDT.
2) La liste de configuration des conteneurs A&B de données AT ou S-0-0371 doit comporter tous les paramètres configurés des conteneurs de données AT.
3) Ces deux listes de configuration sont accessibles en écriture en phase CP2 uniquement.

b) Listes des IDN des paramètres configurables
   1) Tous les paramètres configurables relatifs au conteneur de données MDT peuvent être archivés dans la liste des IDN de données configurables (S-0-0445) du conteneur de données MDT.
   2) Tous les paramètres configurables relatifs au conteneur de données AT peuvent être archivés dans la liste des IDN de données configurables (S-0-0444) du conteneur de données AT.

Les paramètres suivants sont définis:

- liste de configuration de conteneurs A&B de données MDT ou S-0-0370
- liste de configuration de conteneurs A&B de données AT ou S-0-0371
- liste des IDN de données configurables dans le conteneur de données MDT ou S-0-0445
- liste des IDN de données configurables dans le conteneur de données AT ou S-0-0444

6.5.2.4 Adressage du conteneur de données standard

Le pointeur de conteneur de données correspond au décalage de la liste de configuration des conteneurs de données (liste de configuration de conteneurs A&B de données MDT ou S-0-0370 et liste de configuration de conteneurs A&B de données AT ou S-0-0371) du début de ladite liste à l'IDN souhaité. Le maître place le paramètre souhaité dans le conteneur de données MDT, tandis que l'esclave place le paramètre souhaité dans le conteneur de données AT.

- Le pointeur du conteneur A de données (S-0-0368) et
- le pointeur de conteneur B de données (S-0-0369) sont spécifiés.

Chaque pointeur de conteneur de données comporte deux pointeurs de 8 bits.

- Un pointeur de 8 bits adresse les IDN dans la liste de configuration des conteneurs A&B de données MDT (S-0-0370). Le paramètre de l'IDN sélectionné doit être placé dans le conteneur de données MDT.
- L'autre pointeur de 8 bits adresse les IDN dans la liste de configuration des conteneurs A&B de données AT (S-0-0371). Le paramètre de l'IDN sélectionné doit être placé dans le conteneur de données AT.

Les pointeurs de conteneurs de données (S-0-0368&S-0-0369) doivent être configurés dans le MDT dans la mesure où le maître commande à l'esclave d'interpréter les conteneurs de données (voir Figure 40). De ce fait, une commutation des paramètres dans le conteneur de données pendant un cycle de communication est possible.

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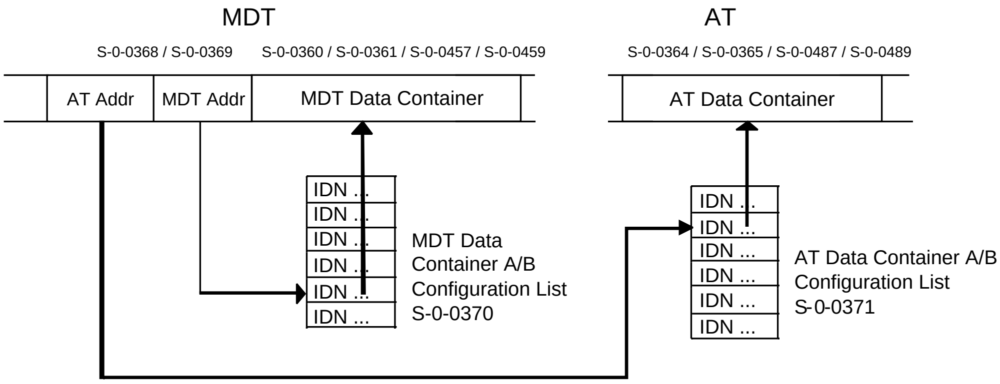

Légende

Anglais	Français
AT Addr	Adr AT
MDT Addr	Adr MDT
MDT data container	Conteneur de données MDT
AT data container	Conteneur de données AT
Configuration list	Liste de configuration

Figure 40 – Configuration de conteneurs de données sans acquittement (esclave)

6.5.2.5 Acquittement du conteneur de données standard

Lorsque le maître exige un acquittement de la transmission des conteneurs de données, il a alors deux possibilités.

- Configurer le pointeur de conteneurs de données identiques, ainsi que dans le télégramme AT.
- Lire le pointeur de conteneurs de données identiques, via la SVC.

L'esclave doit générer l'acquittement par reproduction du pointeur de conteneurs de données du télégramme MDT au télégramme AT.

L'esclave doit acquitter le pointeur de 8 bits dans le télégramme AT avec la valeur 255 (non valide) si

- le pointeur se situe hors des listes de configuration pour le conteneur de données MDT ou AT, ou
- le paramètre est plus important que le conteneur de données.

Dans ce cas, le maître et l'esclave doivent ignorer le conteneur de données correspondant (voir Figure 41).

Le maître doit comparer le pointeur de conteneurs de données (S-0-0368&S-0-0369) des télégrammes MDT et AT. Lorsque le résultat est identique, l'esclave accepte alors les données dans le conteneur de données MDT ou saisit les données demandées dans le conteneur de données AT.

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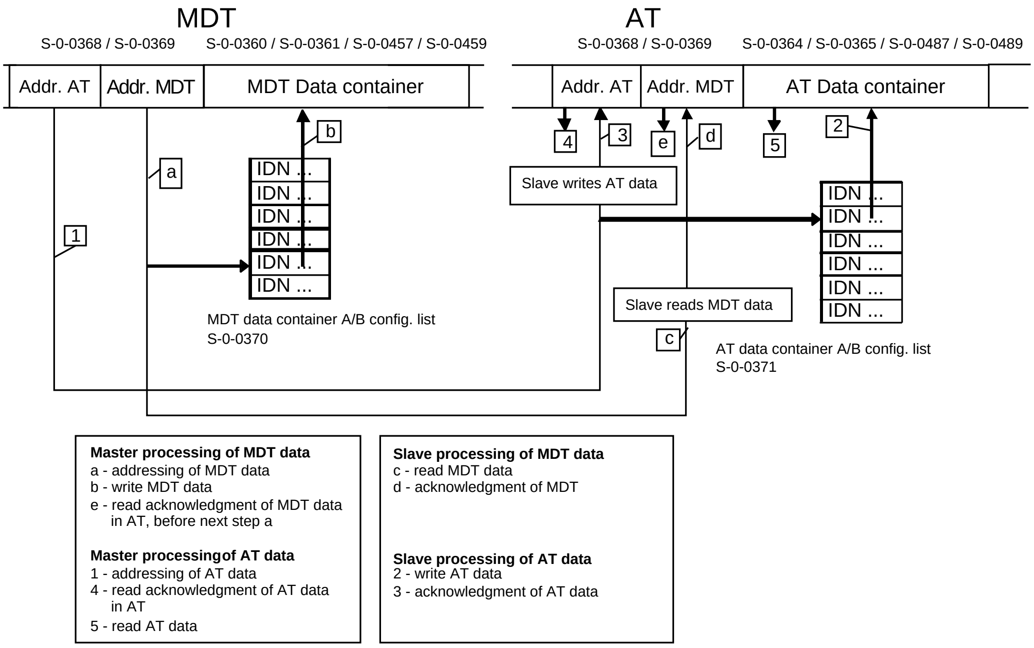

Légende

Anglais	Français
AT Addr	Adr AT
MDT Addr	Adr MDT
MDT data container	Conteneur de données MDT
AT data container	Conteneur de données AT
Slave writes AT data	L'esclave écrit les données AT
MDT data container A/B config. List	liste de configuration de conteneur A/B de données MDT
AT data container A/B config. List	liste de configuration de conteneur A/B de données AT
Master processing of MDT data	Traitement du maître des données MDT
Addressing of MDT data	Adressage des données MDT
Write MDT data	Ecriture de données MDT
Read acknowledgment of MDT data in AT, before nexstep a	Lecture d'acquittement de données MDT dans AT, avant nexstep a
Master processing AT data	Traitement du maître des données AT
Addressing of AT data	Adressage des données AT
Write MDT data	Ecriture de données MDT
Read acknowledgment of AT data in AT	Lecture d'acquittement de données AT dans AT
Read AT data	Lecture de données AT
Slave processing of MDT data	Traitement de l'esclave des données MDT
Read MDT data	Lecture de données MDT
Acknowledgment of MDT	Acquittement de MDT
Slave processing of AT data	Traitement de l'esclave des données AT
Write AT data	Ecriture de données AT
Acknowledgment of AT data	Acquittement de données AT

Figure 41 – Configuration de conteneurs de données avec acquittement (esclave)

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6.5.2.6 Adressage avec index de liste (listes de paramètres)

Si au moins un paramètre de "longueur variable" (c'est-à-dire paramètre de liste) a été programmé dans la "liste de configuration de conteneurs A/B de données", ces données sont trop longues pour un conteneur de données. Dans ce cas

a) l'élément de liste correspondant est adressé via l'index de liste, et par conséquent

b) la longueur du paramètre de liste ne doit pas être modifiée.

Quatre index de liste de conteneurs de données sont spécifiés, avec un index pour chaque conteneur de données:

a) index de liste de conteneurs A de données MDT ou IDN S-0-0362;

b) index de liste de conteneurs B de données MDT ou IDN S-0-0363;

c) index de liste de conteneurs A de données AT ou IDN S-0-0366;

d) index de liste de conteneurs B de données AT ou IDN S-0-0367.

Chaque index de liste de conteneurs de données consiste en une adresse de 16 bits.

Les index de liste de conteneurs de données doivent être configurés dans le MDT dans la mesure où le maître commande à l'esclave d'interpréter les conteneurs de données. De ce fait, une commutation des éléments de liste dans le conteneur de données pendant un cycle de communication est possible.

Chaque index de liste de conteneurs de données consiste en une adresse de 16 bits.

Les index de liste de conteneurs de données doivent être configurés dans le MDT dans la mesure où le maître commande à l'esclave d'interpréter les conteneurs de données. De ce fait, une commutation des éléments de liste dans le conteneur de données pendant un cycle de communication est possible.

Lorsque le maître exige un acquittement de la transmission des conteneurs de données, il a alors deux possibilités.

a) Configurer l'index de liste de conteneurs de données identiques, ainsi que dans le télégramme AT;

b) Lire l'index de liste de conteneurs de données identiques, via la SVC.

L'esclave doit générer l'acquittement par reproduction de l'index de liste de conteneurs de données du télégramme MDT au télégramme AT.

L'esclave doit acquitter l'index de liste de conteneurs de données dans le télégramme AT, avec la valeur 65 535 (non valide), lorsque l'index de liste de conteneurs de données se situe hors de la longueur du paramètre de liste. Dans ce cas, le maître et l'esclave doivent ignorer le conteneur de données correspondant. Eventuellement, l'esclave peut acquitter le pointeur du conteneur de données correspondant dans le télégramme AT avec la valeur 255 (non valide).

Le maître doit comparer l'index de liste de conteneurs de données des télégrammes MDT et AT. Lorsque le résultat est identique, l'esclave accepte alors les données dans le conteneur de données MDT ou saisit les données demandées dans le conteneur de données AT.

La Figure 42 présente le traitement des éléments de listes via les conteneurs de données avec l'index de liste.

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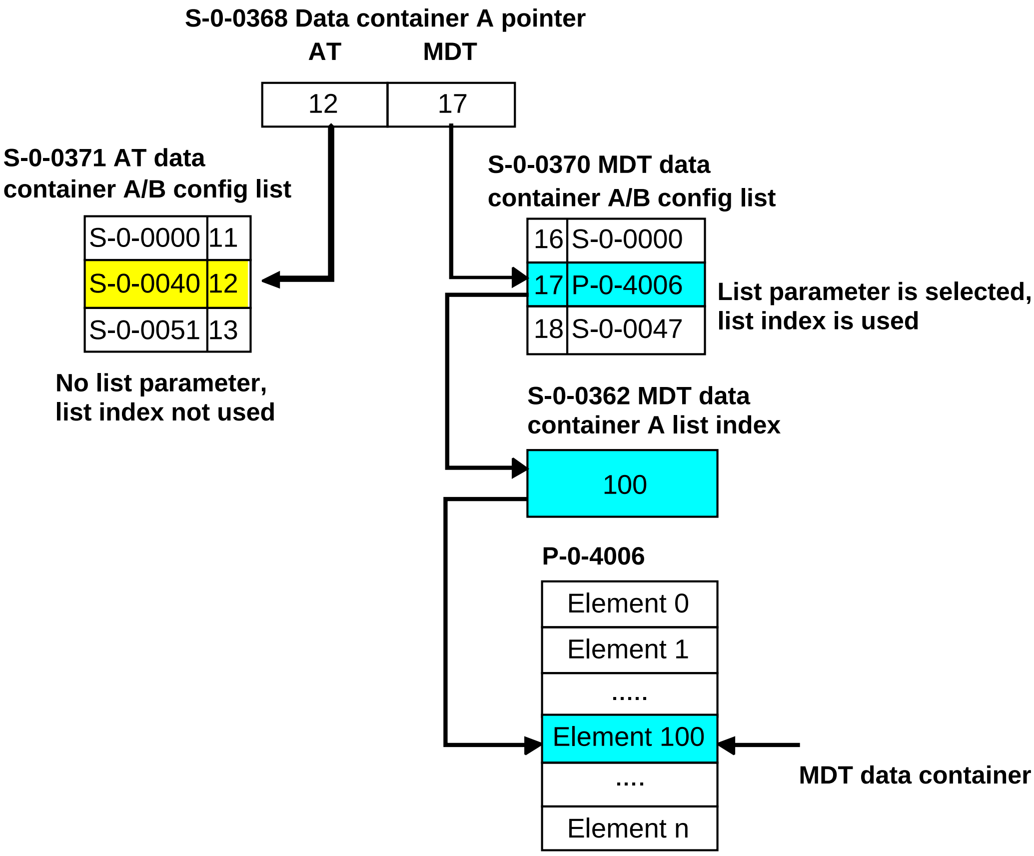

Légende

Anglais	Français
AT data container A/B config list	Liste de configuration de conteneur A/B de données AT
MDT data container A/B config list	Liste de configuration de conteneur A/B de données MDT
No list parameter, list index not used	Pas de paramètre de liste, index de liste non utilisé
List parameter is selected, list index is used	Paramètre de liste sélectionné, index de liste utilisé
MDT data container A list index	Index de liste de conteneurs A de données MDT
Element	Elément
MDT data container	Conteneur de données MDT

Figure 42 – Traitement de l'index de liste dans les données MDT

6.5.3 Fonctionnalité du conteneur de données étendu (fonction préférentielle)

6.5.3.1 Généralités

Le conteneur de données étendu propose une commutation multiplexé entre différentes données d'application dans les télégrammes MDT et AT avec un mécanisme d'adressage commun.

Il convient que les conteneurs de données soient configurés dans les télégrammes MDT et AT pour pouvoir utiliser ce mécanisme.

Les conteneurs de données étendus permettent:

a) d'échanger un plus grand nombre de données dans les télégrammes MDT et AT malgré la longueur limitée des connexions;

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b) d'accéder aux éléments de liste discrets grâce aux paramètres d'index de liste des MDT et AT;

c) de transférer des données d'application multiplexées dans chaque cycle de communication avec une durée de cycle associée à un nombre tscyc * de niveaux de multiplexage par incrémentation de l'adressage.

Il existe 8 conteneurs de données avec une longueur de 4 octets et 2 conteneurs de données avec une longueur de 8 octets, définis pour MDT et AT.

6.5.3.2 Conteneurs de données (étendus)

Il existe 10 conteneurs de données définis pour le télégramme MDT et 10 autres définis pour le télégramme AT, utilisés comme paramètres fictifs. Le maître peut, si nécessaire, modifier le contenu des conteneurs de données de manière dynamique.

Le maître saisit les paramètres dans l'esclave au moyen de "conteneurs de données MDT".

Le maître lit les paramètres en provenance de l'esclave au moyen de "conteneurs de données AT".

Les "conteneurs de données étendus" spécifiés sont énumérés ci-dessous:

a) Conteneur de données MDT
   1) IDN S-0-0360 conteneur A1 de données MDT
   2) IDN S-0-0450 conteneur A2 de données MDT
   3) IDN S-0-0451 conteneur A3 de données MDT
   4) IDN S-0-0452 conteneur A4 de données MDT
   5) IDN S-0-0453 conteneur A5 de données MDT
   6) IDN S-0-0454 conteneur A6 de données MDT
   7) IDN S-0-0455 conteneur A7 de données MDT
   8) IDN S-0-0456 conteneur A8 de données MDT
   9) IDN S-0-0457 conteneur A9 de données MDT
   10) IDN S-0-0458 conteneur A10 de données MDT
b) Conteneur de données AT
   1) IDN S-0-0364 conteneur A1 de données AT
   2) IDN S-0-0480 conteneur A2 de données AT
   3) IDN S-0-0481 conteneur A3 de données AT
   4) IDN S-0-0482 conteneur A4 de données AT
   5) IDN S-0-0483 conteneur A5 de données AT
   6) IDN S-0-0484 conteneur A6 de données AT
   7) IDN S-0-0485 conteneur A7 de données AT
   8) IDN S-0-0486 conteneur A8 de données AT
   9) IDN S-0-0487 conteneur A9 de données AT
   10) IDN S-0-0488 conteneur A10 de données AT

Toute combinaison de "conteneur de données MDT" peut être sélectionnée pour le télégramme MDT. Toute combinaison de "conteneur de données AT" peut être sélectionnée pour le télégramme AT.

Les conteneurs de données doivent être configurés en phase CP2 uniquement.

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Lorsqu'un paramètre transmis est moins important que son conteneur de données, il doit être placé sur la partie inférieure du conteneur de données. Dans ce cas, la partie supérieure reste libre, et respectivement non valide.

6.5.3.3 Configuration du conteneur de données étendu

a) Listes de configuration (générales)
   1) Chaque conteneur de données MDT et chaque conteneur de données AT correspondent exclusivement à leur liste de configuration de conteneurs de données.
   2) Les listes de configuration peuvent être écrites en phase CP2 uniquement.
b) Listes de configuration (MDT)
   1) Toutes les listes de configuration de conteneurs de données MDT utilisées doivent avoir la même longueur.
   2) Les éléments de liste non utilisés doivent être programmés avec l'IDN S-0-0000.
   3) Lorsque des paramètres de "longueur variable" (c'est-à-dire paramètre de liste) sont programmés dans une liste de configuration de conteneurs de données MDT, ces paramètres de liste doivent alors avoir la même longueur.
c) Listes de configuration (AT)
   1) Toutes les listes de configuration de conteneurs de données AT utilisées doivent avoir la même longueur.
   2) Les éléments de liste non utilisés doivent être programmés avec l'IDN S-0-0000.
   3) Lorsque des paramètres de "longueur variable" (c'est-à-dire paramètre de liste) sont programmés dans une liste de configuration de conteneurs de données AT, ces paramètres de liste doivent alors avoir la même longueur.
d) Paramètres configurables
   1) Tous les paramètres configurables relatifs au conteneur de données MDT sont archivés éventuellement (option) dans les listes des IDN de données configurables (IDN S-0-0445).
   2) Tous les paramètres configurables relatifs au conteneur de données AT sont archivés éventuellement (option) dans les listes des IDN de données configurables (IDN S-0-0444).

Lors du "contrôle de transition de CP3" de la commande de procédure (IDN S-0-0127), l'esclave peut vérifier les restrictions indiquées concernant la même longueur de paramètres de liste. En cas de résultat négatif, la commande de procédure génère le code d'erreur dans le numéro de diagnostic (IDN S-0-0390).

Toutes les listes de configuration de conteneurs de données étendus sont énumérées ci-dessous:

a) Listes de configuration de conteneurs de données MDT
   1) IDN S-0-0370 liste de configuration de conteneur A/B de données MDT
   2) IDN S-0-0490 liste de configuration de conteneur A2 de données MDT
   3) IDN S-0-0491 liste de configuration de conteneur A3 de données MDT
   4) IDN S-0-0492 liste de configuration de conteneur A4 de données MDT
   5) IDN S-0-0493 liste de configuration de conteneur A5 de données MDT
   6) IDN S-0-0494 liste de configuration de conteneur A6 de données MDT
   7) IDN S-0-0495 liste de configuration de conteneur A7 de données MDT
   8) IDN S-0-0496 liste de configuration de conteneur A8 de données MDT
   9) IDN S-0-0497 liste de configuration de conteneur A9 de données MDT
   10) IDN S-0-0498 liste de configuration de conteneur A10 de données MDT

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b) Listes de configuration de conteneurs de données AT
   1) IDN S-0-0371 liste de configuration de conteneur A/B de données AT
   2) IDN S-0-0500 liste de configuration de conteneur A2 de données AT
   3) IDN S-0-0501 liste de configuration de conteneur A3 de données AT
   4) IDN S-0-0502 liste de configuration de conteneur A4 de données AT
   5) IDN S-0-0503 liste de configuration de conteneur A5 de données AT
   6) IDN S-0-0504 liste de configuration de conteneur A6 de données AT
   7) IDN S-0-0505 liste de configuration de conteneur A7 de données AT
   8) IDN S-0-0506 liste de configuration de conteneur A8 de données AT
   9) IDN S-0-0507 liste de configuration de conteneur A9 de données AT
   10) IDN S-0-0508 liste de configuration de conteneur A10 de données AT
c) Listes des IDN de données configurables
   1) IDN S-0-0445 liste des IDN de données configurables dans le conteneur de données MDT
   2) IDN S-0-0444 liste des IDN de données configurables dans le conteneur de données AT

6.5.3.4 Adressage du conteneur de données étendu

Le pointeur de conteneur de données correspond au décalage de toutes les listes de configuration de conteneurs de données utilisées, du début de la liste de configuration à l'IDN souhaité. Le maître place le paramètre souhaité dans le conteneur de données MDT, tandis que l'esclave place le paramètre souhaité dans le conteneur de données AT.

Seul le pointeur de conteneur A de données (IDN S-0-0368) est requis, et s'applique par ailleurs à tout conteneur de données.

Le pointeur de conteneur A de données comporte deux pointeurs de 8 bits.

- Un pointeur de 8 bits adresse les IDN dans les listes de configuration des conteneurs de données MDT (IDN S-0-0370, IDN S-0-0490 à IDN S-0-0498). Le paramètre de l'IDN sélectionné doit être placé dans le conteneur de données MDT.
- L'autre pointeur de 8 bits adresse les IDN dans les listes de configuration des conteneurs de données AT (IDN S-0-0371, IDN S-0-0500 à IDN S-0-0508). Le paramètre de l'IDN sélectionné doit être placé dans le conteneur de données AT.

Le pointeur de conteneur A de données (IDN S-0-0368) doit être configuré dans le MDT dans la mesure où le maître commande à l'esclave d'interpréter les conteneurs de données.

La Figure 43 présente un exemple de listes de configuration avec 32 niveaux.

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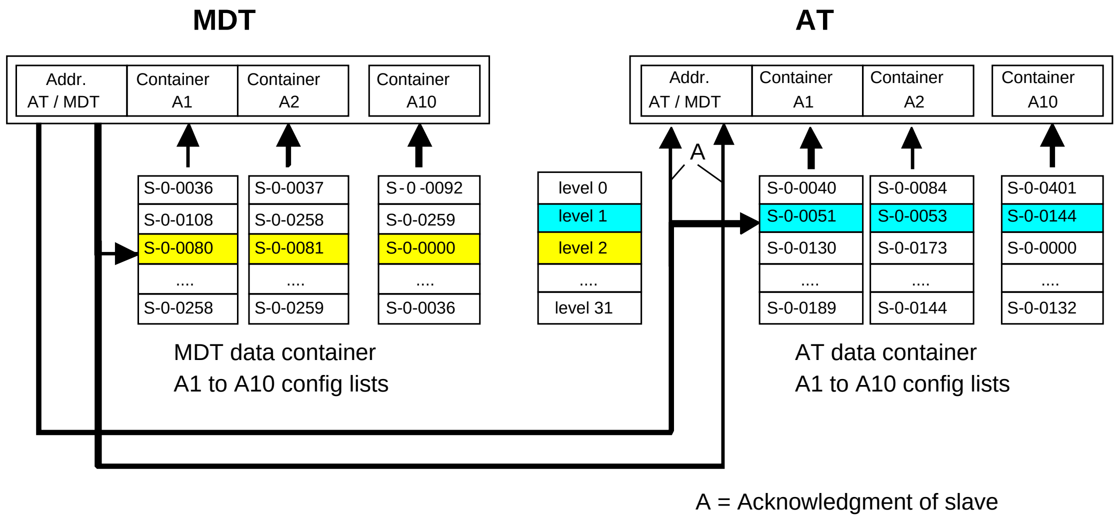

Légende

Anglais	Français
Addr AT / MDT	Adr AT / MDT
Container	Conteneur
Level	Niveau
MDT data container A1 to A10 config lists	Listes de configuration de conteneur A1 à A10 de données MDT
AT data container A1 to A10 config lists	Listes de configuration de conteneur A1 à A10 de données AT
A = acknowledgment of slave	A = acquittement de l'esclave

Figure 43 – Structure de conteneur de données étendu

6.5.3.5 Acquittement du conteneur de données étendu

Lorsque le maître exige un acquittement de la transmission des conteneurs de données, il a alors deux possibilités.

- Configurer le pointeur de conteneur A de données, ainsi que dans le télégramme AT;
- Lire le pointeur de conteneur A de données via la SVC.

L'esclave doit générer l'acquittement par reproduction du pointeur de conteneur A de données du télégramme MDT au télégramme AT.

L'esclave doit acquitter le pointeur de 8 bits dans le télégramme AT avec la valeur 255 (non valide) si

- le pointeur se situe hors des listes de configuration pour le conteneur de données MDT ou AT, ou
- le paramètre est plus important que le conteneur de données.

Dans ce cas, le maître et l'esclave doivent ignorer tous les conteneurs de données dont le pointeur de 8 bits a la charge.

Le maître doit comparer le pointeur de conteneur A de données (IDN S-0-0368) des télégrammes MDT et AT. Lorsque le résultat est identique, l'esclave accepte alors les données dans le conteneur de données MDT ou saisit les données demandées dans le conteneur de données AT.

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6.5.3.6 Adressage avec index de liste

Si au moins un paramètre de "longueur variable" (c'est-à-dire paramètre de liste) a été programmé dans la "liste de configuration de conteneurs de données", ces données sont trop longues pour un conteneur de données. Dans ce cas

- l'élément de liste correspondant est adressé via l'index de liste, et par conséquent
- la longueur du paramètre de liste ne doit pas être modifiée et
- la longueur de tous les paramètres de liste sélectionnés doit être identique.

Deux index de liste de conteneurs de données sont spécifiés:

- l'index de liste de conteneurs A de données MDT (IDN S-0-0362) pour tous les conteneurs de données MDT
- l'index de liste de conteneurs A de données AT (IDN S-0-0366) pour tous les conteneurs de données AT

Chaque index de liste de conteneurs de données consiste en une adresse de 16 bits.

L'index de liste de conteneurs A de données doit être configuré dans le MDT dans la mesure où le maître commande à l'esclave d'interpréter les conteneurs de données. De ce fait, une commutation des éléments de liste dans le conteneur de données pendant un cycle de communication est possible.

Lorsque le maître exige un acquittement de la transmission des conteneurs de données, il a alors deux possibilités.

- Configurer l'index de liste de conteneurs de données identiques, ainsi que dans le télégramme AT.
- Lire l'index de liste de conteneurs de données identiques, via la SVC.

L'esclave doit générer l'acquittement par reproduction de l'index de liste de conteneurs de données du télégramme MDT au télégramme AT.

L'esclave doit acquitter l'index de liste de conteneurs de données dans le télégramme AT, avec la valeur 65535 (non valide), lorsque l'index de liste de conteneurs de données se situe hors de la longueur de l'un des paramètres de liste sélectionnés. Dans ce cas, le maître et l'esclave doivent ignorer tous les conteneurs de données correspondants. Eventuellement, l'esclave peut acquitter le pointeur du conteneur de données correspondant dans le télégramme AT avec la valeur 255 (non valide).

Le maître doit comparer l'index de liste de conteneurs de données des télégrammes MDT et AT. Lorsque le résultat est identique, l'esclave accepte alors les données dans le conteneur de données MDT ou saisit les données demandées dans le conteneur de données AT.

6.5.4 Diagnostic de conteneur de données

Les paramètres des conteneurs de données sont vérifiés lors de l'initialisation, ainsi que pendant le fonctionnement en phase CP4. Lorsqu'un esclave détecte une erreur dans le conteneur de données, il génère le message de diagnostic correspondant.

- Données non configurables: L'IDN ne peut pas être configuré dans le conteneur de données MDT ou AT. Il faut qu’il s'assure que les IDN des listes de configuration peuvent être transmis sous forme de données cycliques. L'esclave vérifie cet IDN à l'aide de la commande de procédure IDN S-0-0127.
- Adressage invalide: En phase CP4, l'esclave vérifie si l'adressage s'effectue hors des listes de configuration. En cas d'erreur manifeste, l'adressage approprié dans le télégramme AT est fixé à 255. Le contenu des conteneurs de données n'est pas valide. Par conséquent, la longueur de programmation de toutes les listes de configuration doit

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être identique. Il faut que les éléments de liste non utilisés soient programmés avec l'IDN S-0-0000.

En phase CP4, l'esclave vérifie si l'index de liste se situe hors du paramètre de liste. En cas d'erreur manifeste, l'index de liste approprié est fixé à 65535. Eventuellement, l'adressage approprié dans le télégramme AT est fixé à 255. Par conséquent, la longueur de programmation de tous les paramètres de liste doit être identique. Il faut que les éléments de liste non utilisés soient réglés sur 0x0.

- Si l'adressage du conteneur de données MDT est invalide, l'esclave peut alors régler le Numéro de diagnostic (S-0-0390) sur 0xC30E0008.
- Si l'adressage du conteneur de données AT est invalide, l'esclave peut alors régler le Numéro de diagnostic (S-0-0390) sur 0xC30E0009.

6.6 Traitement des bits en temps réel

6.6.1 Généralités

Le groupe de fonctions Bits en temps réel (FG RTB) comporte 3 options d'échange des bits en temps réel (par exemple, signaux ou événements) entre les nœuds de Type 19.

- Option 1: Deux bits en temps réel sont définis dans la commande de connexion. Ceux-ci font partie des données d'application.
- Option 2: Un conteneur de mots RTB utilisé comme producteur et un autre utilisé comme consommateur.
- Option 3: Un conteneur de listes RTB utilisé comme producteur et un autre utilisé comme consommateur.

Les bits en temps réel de la connexion de consommation sont différenciés des bits en temps réel de la connexion de production. Toutes les attributions logiques doivent être des IDN de données binaires d'exploitation (par exemple, niveau de signaux de commutation, bits, etc.).

Le maître doit attribuer uniquement des IDN pris en charge par l'esclave dans la "liste des IDN de bits en temps réel configurables".

Tous les bits en temps réel activés par l'intermédiaire de ces attributions, conservent leur signification jusqu'à ce que le maître les "écrase" ou les efface avec l'IDN S-0-0-000 ou jusqu'à ce qu'un autre IDN modifie l'affectation logique.

Lorsqu'il existe un accès en écriture, via la voie de service aux données d'exploitation d'un IDN attribué à un bit en temps réel, l'esclave génère le message d'erreur "données d'exploitation protégées en écriture, avec configuration cyclique (code d'erreur 0x700A)" via la voie de service.

Ce groupe de fonctions inclut les IDN suivants:

- S-0-0026 Affectation des IDN de conteneur de mots RTB du producteur
- S-0-0027 Affectation des IDN de conteneur de mots RTB du consommateur
- S-0-0144 Conteneur de mots RTB du producteur
- S-0-0145 Conteneur de mots RTB du consommateur
- S-0-0328 Affectation de bits de conteneur de mots RTB du producteur
- S-0-0329 Affectation de bits de conteneur de mots RTB du consommateur
- S-0-0398 Liste des IDN de bits en temps réel configurables utilisés comme producteur
- S-0-0399 Liste des IDN de bits en temps réel configurables utilisés comme consommateur
- S-0-1050.x.20 Affectation des IDN de bits en temps réel

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- S-0-1050.x.21 Affectation de bits en temps réel
- S-0-1080.x.02 Conteneur de listes RTB du producteur
- S-0-1080.x.03 Affectation des IDN de conteneur de listes RTB du producteur
- S-0-1080.x.04 Affectation de bits de conteneur de listes RTB du producteur
- S-0-1081.x.02 Conteneur de listes RTB du consommateur
- S-0-1081.x.03 Affectation des IDN de conteneur de listes RTB du consommateur
- S-0-1081.x.04 Affectation des IDN de conteneur de listes RTB du consommateur

et les bits de commande et d'état suivants

- C-CON/Bit 1 en temps réel
- C-CON/Bit 2 en temps réel

6.6.2 Bits en temps réel (RTB)

Deux bits en temps réel sont définis dans la commande de connexion (C-CON), qui peuvent être utilisés avec des attributions particulières. Les attributions sont transmises, à la demande, par l'intermédiaire de la voie de service. Les bits en temps réel, représentant des signaux, indiquent un certain état ou événement sélectionné (par exemple, niveau des signaux de commutation, bits, etc.) dans le maître ou les esclaves. Cet état ou événement entre le producteur et les consommateurs est représenté en temps réel.

Le consommateur doit évaluer les bits en temps réel dans la commande de connexion seulement, si la surveillance du mécanisme de connexion a été correctement menée.

Une signification logique est attribuée aux bits en temps réel via les attributions suivantes:

- Le maître utilise les attributions S-0-1050.x.20 et S-0-1050.x.21 pour informer le producteur et le consommateur de la valeur logique attribuée au bit 1 en temps réel ou au bit 2 en temps réel dans la commande de connexion.
- Pour le bit 1 en temps réel, le maître doit configurer l'élément de liste 0 de S-0-1050.x.20 et S-0-1050.x.21.
- Pour le bit 2 en temps réel, le maître doit configurer l'élément de liste 1 de S-0-1050.x.20 et S-0-1050.x.21.
- Les bits en temps réel doivent toujours être protégés en écriture dans une connexion de production.

Pour l'utilisation des bits en temps réel, les paramètres suivants sont disponibles:

- C-CON/Bit 1 en temps réel
- C-CON/Bit 2 en temps réel
- S-0-0398 Liste des IDN de bits en temps réel configurables utilisés comme producteur
- S-0-0399 Liste des IDN de bits en temps réel configurables utilisés comme consommateur
- S-0-1050.x.20 Affectation des IDN de bits en temps réel
- S-0-1050.x.21 Affectation de bits en temps réel

6.6.3 Conteneur de mots RTB

Les bits en temps réel (par exemple, signaux ou événements) peuvent être échangés entre les nœuds de Type 19 via le conteneur de mots RTB (voir S-0-0144 et S-0-0145). A cette fin, le conteneur de mots RTB doit être intégré dans une connexion de production et/ou de consommation. Les bits internes au conteneur de mots RTB peuvent être définis grâce à l'affectation des IDN du conteneur de mots RTB (voir S-0-0026 et S-0-0027) et à l'affectation des bits de ce même conteneur (voir S-0-0328 et S-0-0329).

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La séquence des IDN dans l'affectation des IDN détermine le programme de numérotation des bits dans le conteneur de mots RTB. Le premier IDN (élément de liste 0) de l'affectation des IDN définit le bit 0, le dernier IDN (élément de liste 15) définit le bit 15 du conteneur de mots RTB. L'affectation de bits définit le bit utilisé pour chaque IDN attribué. Lorsque l'affectation de bits n'est pas prise en charge par l'esclave, le bit 0 de l'IDN attribué est configuré automatiquement.

L'exemple donné dans le Tableau 85 illustre l'affectation des IDN et des bits du conteneur RTB du producteur.

Le conteneur de mots RTB a une longueur de 2 octets et doit toujours être protégé en écriture dans une connexion de production.

Pour l'utilisation du conteneur de mots RTB, les paramètres suivants sont disponibles:

Conteneur de mots RTB dans une connexion de production

- S-0-0026 Affectation des IDN de conteneur de mots RTB du producteur
- S-0-0144 Conteneur de mots RTB du producteur
- S-0-0328 Affectation de bits de conteneur de mots RTB du producteur
- S-0-0398 Liste des IDN de bits en temps réel configurables utilisés comme producteur

Conteneur de mots RTB dans une connexion de consommation

- S-0-0027 Affectation des IDN de conteneur de mots RTB du consommateur
- S-0-0145 Conteneur de mots RTB du consommateur
- S-0-0329 Affectation de bits de conteneur de mots RTB du consommateur
- S-0-0399 Liste des IDN de bits en temps réel configurables utilisés comme consommateur

6.6.4 Conteneur de listes RTB

Les bits en temps réel (par exemple, signaux ou événements) peuvent être échangés entre les nœuds de Type 19 via le conteneur de listes RTB (voir S-0-1080.x.02 et S-0-1081.x.02). A cette fin, le conteneur de listes RTB doit être intégré dans une connexion de production et/ou de consommation. Les bits internes au conteneur de listes RTB peuvent être définis grâce à l'affectation des IDN du conteneur de listes RTB (voir S-0-1080.x.03 et S-0-1081.x.03) et à l'affectation des bits de ce même conteneur (voir S-0-1080.x.04 et S-0-1081.x.04).

La séquence des IDN dans l'affectation des IDN détermine le programme de numérotation des bits dans le conteneur de listes RTB. Le premier IDN (élément de liste 0) de l'affectation des IDN définit le bit 0, le dernier IDN (élément de liste n) définit le bit (n) du conteneur de listes RTB. L'affectation de bits définit le bit utilisé pour chaque IDN attribué.

L'exemple donné dans le Tableau 85 illustre l'affectation des IDN et des bits d'un conteneur RTB du producteur.

Le conteneur de listes RTB doit avoir une longueur variable avec un nombre pair d'octets et doit toujours être protégé en écriture dans une connexion de production.

Pour l'utilisation du conteneur de listes RTB, les paramètres suivants sont disponibles:

Conteneur de listes RTB dans une connexion de production

- S-0-0398 Liste des IDN de bits en temps réel configurables utilisés comme producteur
- S-0-1080.x.02 Conteneur de listes RTB du producteur
- S-0-1080.x.03 Affectation des IDN de conteneur de listes RTB du producteur

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- S-0-1080.x.04 Affectation de bits de conteneur de listes RTB du producteur

Conteneur de listes RTB dans une connexion de consommation

- S-0-0399 Liste des IDN de bits en temps réel configurables utilisés comme consommateur
- S-0-1081.x.02 Conteneur de listes RTB du consommateur
- S-0-1081.x.03 Affectation des IDN de conteneur de listes RTB du consommateur
- S-0-1081.x.04 Affectation des IDN de conteneur de listes RTB du consommateur

Tableau 85 – Exemple d'affectation d'IDN et de bits du conteneur RTB

Numéro de bit du conteneur RTB	Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8	etc.
Affectation d'IDN	S-0-0403	S-0-0013	S-0-0000	S-0-0013	S-0-0013	S-0-0012	S-0-0330	S-0-0403	S-0-0012	…
Affectation de bits	0	5	X	9	0	4	0	1	1	…

NOTE Bit 0 du conteneur RTB: Le bit 0 de S-0-0403 est attribué. Bit 1 du conteneur RTB: Le bit 5 de S-0-0013 est attribué. Bit 2 du conteneur RTB: n'est pas utilisé. Bit 3 du conteneur RTB: Le bit 9 de S-0-0013 est attribué, etc.

6.7 SMP

6.7.1 Définitions

Le protocole de messagerie de Type 19 utilise les Données de conteneur SMP (S-0-1101.x.01) pour transmettre des messages SMP ou des fragments SMP. La longueur du conteneur SMP peut être comprise entre 4 et 258 octets sans aucune restriction. Le conteneur SMP doit être configuré dans une connexion. Par conséquent, la longueur de la connexion doit être supérieure ou égale à celle du conteneur SMP. Deux formats sont définis pour les messages SMP et les fragments SMP respectivement, à savoir le format régulier et le format étendu. Ces deux formats sont choisis au moyen du bit EXTF dans l' entête ''Session Control Header'' (En-tête de commande de session). La longueur du conteneur SMP est définie par la longueur actuelle de S-0-1101.x.01

La Figure 44 présente les deux structures du conteneur SMP.

- Le format régulier contient l'en-tête de commande de session (2 octets) et les données d'application. La taille des données d'application peut être configurée entre 2 octets et 256 octets. La taille des données d'application n'est pas modifiable.
- Le format étendu contient l'en-tête de commande de session et ne peut être rempli que partiellement avec les données d'application. La taille étendue des données d'application transmises est indiquée dans le dernier octet du conteneur SMP. Les tailles étendues des données d'application sont modifiables entre 0 octet et 255 octets dans chaque transmission. Si la taille étendue est égale à 0, le consommateur doit évaluer l'en-tête de commande de session seulement.

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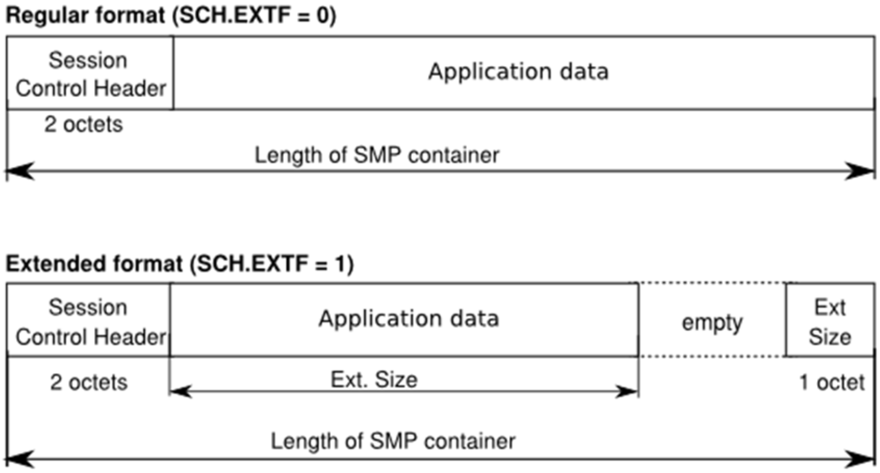

Légende

Anglais	Français
Regular format	Format régulier
Session control header	En-tête de commande de session
Application data	Données d'application
Length of SMP container	Longueur du conteneur SMP
Extended format	Format étendu
Empty	Vide
Ext size	Taille étendue

Figure 44 – Conteneur de transport

NOTE Longueur du conteneur SMP = longueur actuelle de S-0-1101.x.01 Données de conteneur SMP (4 octets à 258 octets)

6.7.2 Structure de l'En-tête de commande de session (SCH)

L'en-tête de commande de session contrôle

- la fragmentation des messages SMP de plus grande taille que les conteneurs SMP utilisés,
- la hiérarchisation des messages SMP, et
- le multiplexage de plusieurs sessions logiques par un conteneur SMP unique.

Sa structure est présentée dans le Tableau 86.

Tableau 86 – Structure de l'En-tête de commande de session

Numéro de bit	Valeur	Description
15-8	—	Identifiant de session (SID) Un conteneur SMP permet de transmettre jusqu'à 255 canaux de transmission logiques (sessions). L'identifiant de session indique la session d'un message SMP pour laquelle les données d'application sont destinées.
	0-254	Valeurs valides pour le SID (0x00–0xFE)
	255	La valeur 255 (0xFF) est réservée pour les services de la couche de transport

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Numéro de bit	Valeur	Description
7	—	Dernier de séquence (LOS): Le conteneur SMP reçu a transporté le dernier fragment SMP d'une séquence de session. Les bits LOS & FOS contrôlent la fragmentation des messages SMP dont la taille dépasse celle du conteneur SMP
	0	fragment SMP d'une session
	1	dernier fragment SMP d'une session
6	—	Premier de séquence (FOS): Le conteneur SMP reçu a transporté le premier fragment SMP d'une séquence de session. Tous les fragments SMP reçus jusqu'à présent à ce niveau de priorité de ce conteneur et pas encore complétés par un bit Last-of-Sequence s(LOS) sont rejetés. Les bits LOS & FOS contrôlent la fragmentation des télégrammes SMP dont la taille dépasse celle du conteneur SMP
	0	fragment SMP d'une session
	1	premier fragment SMP d'une session
5-4	—	Compteur de séquences (SC) Ce compteur est géré séparément pour chaque session. Il est incrémenté pour chaque fragment SMP ou message SMP transmis dans une session. Le SC ne couvre pas les défaillances de transmission survenant dans un message SMP fragmenté.
	0-3	Valeur de compteur de séquences
3-2	—	Priorité (PRI) Correspond à la priorité de la session de transmission de ce message SMP. Conformément à ce champ binaire, la couche de transport peut accorder aux messages SMP à haute priorité (par exemple, données cycliques) un traitement préférentiel par opposition aux messages SMP prioritaires moindre (par exemple, services de configuration non cycliques).
	00	Priorité 0 (niveau le plus élevé)
	01	Priorité 1
	10	Priorité 2
	11	Priorité 3 (niveau le moins élevé)
1	—	Format étendu (EXTF) Ce bit indique que le conteneur SMP en relation avec l'en-tête n'est pasrempli entièrement. Dans ce cas, on saisit le nombre de données d'application réellement inclus dans le dernier octet du conteneur SMP.
	0	Format régulier: le conteneur SMP est rempli complètement
	1	Format étendu : conteneur SMP non rempli complètement. Le consommateur doit évaluer la taille étendue (dernier octet du conteneur SMP)
0	basculement	Basculement de nouvelles données (NDT) Ce bit indique que le contenu du conteneur SMP (c'est-à-dire l'en-tête de commande de session ou le champ de données d'application) a été modifié. Il est nécessaire que le consommateur évalue uniquement le

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Numéro de bit	Valeur	Description
		conteneur SMP lorsque l'état de ce bit a été modifié.
	0/1	Valeur actuelle

6.7.3 Séquence d'évaluation de l'en-tête de commande de session par le consommateur

Le consommateur doit évaluer le message SMP dans une séquence définie comme suit:

- Le consommateur doit évaluer le basculement de nouvelles données (NDT)
  - S'il a basculé (NDT != int.NDT), un nouveau fragment SMP a été alors reçu. Le consommateur doit continuer à évaluer le fragment SMP et doit modifier son attente. Par conséquent il doit basculer son bit interne "int.NDT".
- Le consommateur doit vérifier la configuration du SID (Identifiant de session) reçu en S-0-1101.x.02 Liste of des identifiants de session.
  - SI le SID est configuré, le consommateur doit alors continuer à évaluer le fragment SMP.
  - sinon, le consommateur annule l'évaluation.
- Le consommateur doit vérifier la configuration de la PRI (Priorité) reçue en S-0-1101.x.03 Liste des priorités de session.
  - SI la PRI est configurée et correspond au SID, le consommateur doit alors continuer à évaluer le fragment SMP.
  - sinon, le consommateur annule l'évaluation.
- Le consommateur doit vérifier le FOS (Premier de séquence).
  - Si le FOS est réglé sur 1, le consommateur doit alors réinitialiser la mémoire tampon de fragment SMP de la priorité reçue.
  - Le consommateur archive le fragment SMP reçu dans la mémoire tampon correspondante de la priorité.
  - Le consommateur doit régler le SC (Compteur de séquences) reçu sur son SC interne en vue de générer une attente pour le fragment SMP suivant.
- Si le FOS est réglé sur 0 et le fragment SMP reçu n'est pas le premier, le SC doit être alors vérifié avec le SC interne.
  - Si la vérification du SC est valide, le consommateur doit alors archiver le fragment SMP reçu dans la mémoire tampon correspondante de la priorité.
  - Si la vérification du SC est invalide, le consommateur annule l'évaluation et le fragment SMP est rejeté.
- Si le FOS est réglé sur 0 et le fragment SMP reçu est le premier, le consommateur annule l'évaluation et le fragment SMP est rejeté.
- Si le fragment SMP a été archivé et le LOS (Dernier de séquence) est égal à 1, le consommateur doit alors assembler tous les fragments SMP archivés de la mémoire tampon en un message SMP pour le transmettre à l'application.

6.7.4 Multiplexage de deux sessions (exemple)

La Figure 45 illustre un exemple de transmission de deux sessions via un conteneur de transport d'une longueur de 10 octets. Dans la première session (SID 0x7), 8 octets de ''données d'application A'' sont transmis. La seconde session (SID 0x3) permet de transmettre des ''données d'application B'' d'une longueur de 24 octets. Les ''données d'application B'' sont divisées en trois fragments SMP de 8 octets chacun. L'exemple illustre la méthode de contrôle de la fragmentation grâce aux bits FOS et LOS. Le consommateur archive les fragments SMP reçus dans une mémoire tampon de fragment jusqu'à réception de Last-of-Sequence-Fragment (LOS = 1). Indépendamment de la session actuellement

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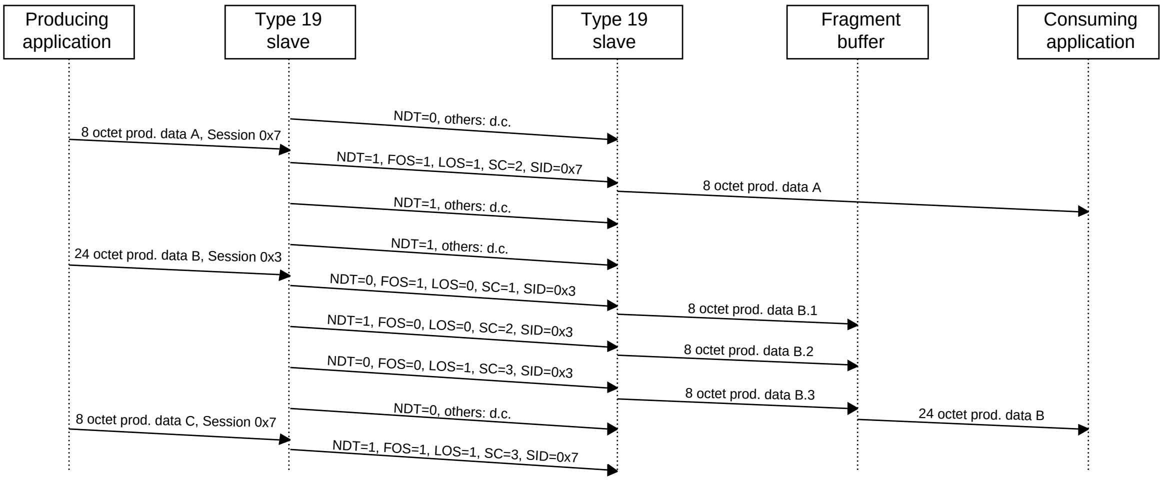
transmise, le bit NDT commute avec chaque message SMP. En l'absence de données d'application pour la transmission de production, le bit NDT ne sera pas basculé dans le message SMP suivant. Dans ce cas, le consommateur n'évalue pas les autres bits de l'en-tête de commande de session et les données d'application du conteneur SMP. Le SC du champ binaire est géré séparément pour chaque session et est incrémenté de chaque message SMP appartenant à une session. Cette opération permet de s'assurer qu'une session à faible priorité peut être interrompue par une session de priorité plus élevée. Une fois la transmission à priorité élevée achevée, la session interrompue est reprise.



Légende

Anglais	Français
Producing application	Application de production
Type 19 slave	Esclave de Type 19
Fragment buffer	Mémoire tampon de fragments
Consuming application	Application de consommation
Others	Autres
8 octet prod. Data A	Données de production A sur 8 octets
24 octet prod. Data B	Données de production B sur 24 octets
8 octet prod. Data C	Données de production C sur 8 octets
8 octet prod. Data B.1	Données de production B.1 sur 8 octets
8 octet prod. Data B.2	Données de production B.2 sur 8 octets
8 octet prod. Data B.3	Données de production B.3 sur 8 octets

Figure 45 – Diagramme de séquences UML: Exemple de multiplexage de deux sessions

6.7.5 Hiérarchisation par ordre de priorité

Le champ priorité (PRI) de l'en-tête de commande de session commande l'ordre de transmission des fragments SMP. Les fragments SMP avec une priorité plus élevée (valeur inférieure dans le champ PRI) doivent être transmis en premier lieu. Les fragments SMP avec un même niveau de priorité doivent être transmis dans le même ordre dans lequel ils avaient été générés par la couche session du SMP.

Ce système de hiérarchisation par ordre de priorité a les caractéristiques suivantes:

- S'il est nécessaire d'envoyer un message SMP pendant qu'une transmission avec une priorité inférieure est en cours, le message SMP de priorité moins élevée sera interrompu. Le message SMP de priorité plus élevée sera envoyé en premier. A l'issue de cet envoi, l'envoi du message SMP de priorité moins élevée sera repris.

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- S’il est nécessaire d’envoyer un message SMP pendant qu’une transmission avec une priorité égale ou supérieure est en cours, le nouveau message SMP est mis en liste d’attente jusqu’à ce que tous les messages SMP en attente de priorité supérieure ou égale aient été transmis.

Une mise en œuvre possible consisterait en un ensemble de quatre files d’attente FIFO (une pour chaque niveau de priorité) qui enregistrent les fragments SMP sortants. Lorsqu’un nouveau message est envoyé par SMP, la couche session divise les données d’application en fragments SMP. Ces fragments SMP sont poussés vers la fin de la file d’attente FIFO associée au niveau de priorité de la session expéditrice. Toutes les fois qu’un nouveau fragment SMP peut être envoyé, la couche réseau de SMP prend le fragment SMP à partir de la file d’attente non-vide la plus prioritaire et le copie dans le conteneur SMP.

6.7.6 Diagnostic de SMP

Le paramètre Diagnostic de SMP IDN S-0-1100 permet la collecte centrale des informations de diagnostic. Ce diagnostic contient les éléments de structure suivants:

a) Fragments SMP transmis par le compteur de diagnostic ou IDN S-0-1100.0.1
b) Fragments SMP reçus par le compteur de diagnostic ou IDN S-0-1100.0.2
c) Fragments SMP rejetés par le compteur de diagnostic ou IDN S-0-1100.0.3

6.7.7 Définition de la structure de paramètres des conteneurs SMP

Le paramètre Conteneur de transport SMP ou IDN S-0-1101 est défini pour le transport de fragments SMP par le conteneur SMP. La structure de ce conteneur est définie par les éléments de structure suivants:

a) Données de conteneur SMP ou IDN S-0-1101.x.01
b) Liste des identifiants de session ou IDN S-0-1101.x.02
c) Liste des priorités de session ou IDN S-0-1101.x.03

L'élément de structure IDN S-0-1101.x.1 est configuré dans un conteneur SMP. Il comprend ainsi les données d’application transmises dans ce conteneur SMP.

Les autres éléments de structure décrivent les sessions actuellement actives pour ce conteneur SMP.

Les listes des éléments IDN S-0-1101.x.2 et IDN S-0-1101.x.3 doivent avoir la même longueur réelle. Les éléments de liste avec index identique décrivent une session.

6.7.8 Exemple

Dans l'exemple suivant, 3 sessions sont actives dans le conteneur 7 SMP (S-0-1101.7.01):

- Session 0x04, priorité 0
- Session 0x05, priorité 3
- Session 0xF3, priorité 0

Tableau 87 – Listes dans S−0−1101.7.x

Elément	S-0-1101.7.2 Liste des identifiants de session	S-0-1101.7.3 Liste des priorités de session
Réel	6	6
Max	20	20
0	0x04	0
1	0x05	3

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Elément	S-0-1101.7.2 Liste des identifiants de session	S-0-1101.7.3 Liste des priorités de session
2	0xF3	0

6.8 Suréchantillonnage

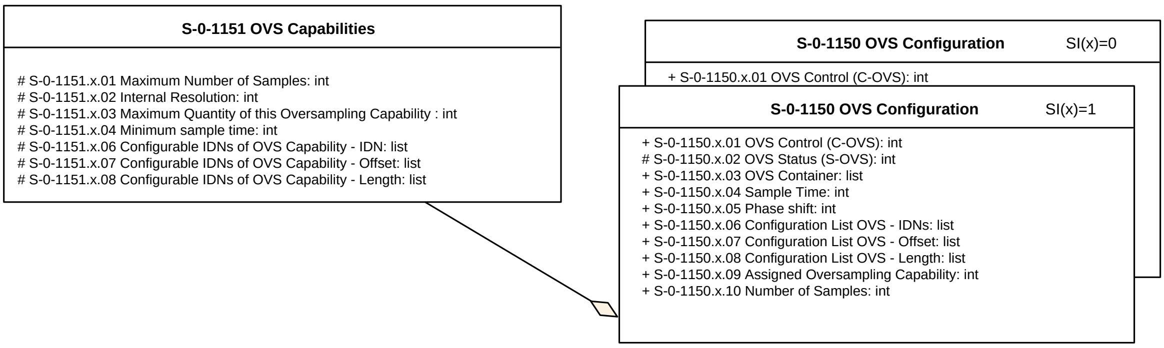
6.8.1 Description

Le suréchantillonnage est une méthode qui permet de recevoir ou d'envoyer un plus grand nombre d'informations (échantillons) concernant un signal (entrées ou sorties) entre deux cycles (de production). N échantillons sont transmis ensemble dans un cycle, ce qui requiert par conséquent au moins N fois autant d'espace télégrammes, par comparaison au signal "normal". La méthode peut être employée tant pour les entrées que pour les sorties.

6.8.2 Généralités

Le suréchantillonnage est décrit dans ce groupe de fonctions. Ce groupe de fonctions comporte deux IDN structurés (voir Figure 46).

- Configuration (S-0-1150): Contient toutes les configurations de suréchantillonnage.
- Capacités (S-0-1151): Décrit l'ensemble des paramètres de ce groupe de fonctions.



Légende

Anglais	Français
OVS capabilities	Capacités OVS
Maximum number of samples	Nombre maximal d'échantillons
Internal resolution	Résolution interne
Maximum quantity of this oversampling capability	Grandeur maximale de cette capacité de suréchantillonnage
Minimum sample time	Durée minimale d'échantillonnage
Configurable IDNs of OVS Capability	IDN configurables de capacité OVS
IDN: list	IDN: liste
Offset: list	Décalage: liste
Length: list	Longueur: liste
OVS configuration	Configuration OVS
OVS control	Commande OVS
OVS status	Etat OVS
OVS container	Conteneur OVS
Sample time	Durée d'échantillonnage
Phase shift	Déphasage
Configuration list OVS	OVS liste de configuration

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Anglais	Français
Assigned oversampling capability	Capacité de suréchantillonnage attribuée
Number of samples	Nombre d'échantillons

Figure 46 – Présentation du suréchantillonnage

6.8.3 Contraintes

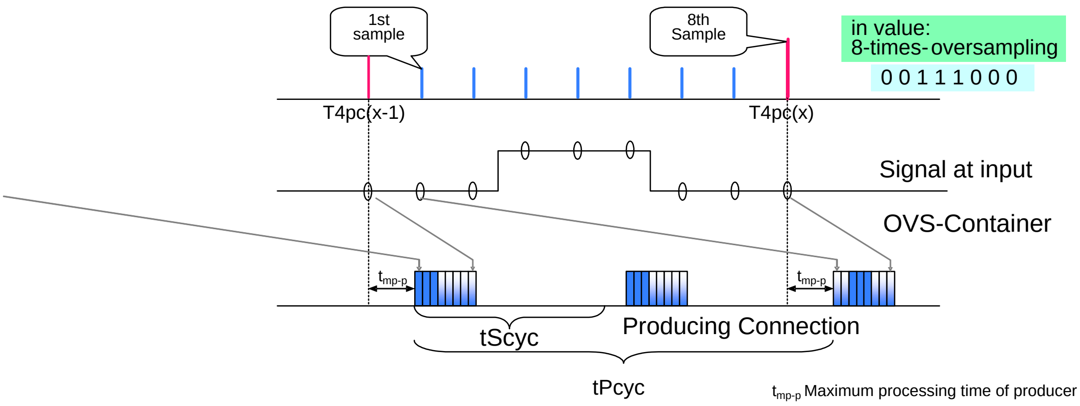
Les contraintes suivantes doivent être prises en compte:

- Le domaine de suréchantillonnage décrit l'ensemble des IDN associés, définissant un automate de suréchantillonnage.
- Il existe précisément une horloge de suréchantillonnage par domaine de même nature.
- La durée d'échantillonnage est une fraction entière de la durée de cycle de production (par exemple, tPcyc = 1 ms, durée d'échantillonnage = 50 μs).
- Les points d'échantillonnage sont équidistants par rapport à la durée.

6.8.4 Entrée de suréchantillonnage

Un ou plusieurs signaux sont échantillonnés dans un cycle de production (tPcyc) avec une horloge d'échantillonnage plus rapide définie. Les valeurs échantillonnées sont combinées dans un conteneur dit de suréchantillonnage, puis transmises dans le cycle de production suivant. Le dernier point d'échantillonnage transmis dans un cycle de production est l'échantillon du cycle T4pc respectif.

La Figure 47 illustre un exemple de tPcyc de 2 * tScyc et de facteur de suréchantillonnage égal à 8.



Légende

Anglais	Français
In value: 8-times- oversampling	Valeur d'entrée: 8 fois le suréchantillonnage
1st sample	1er échantillon
8th sample	8ème échantillon
Signal at input	Signal en entrée
OVS-container	Conteneur OVS
Producing connection	Connexion de production
Maximum processing time of producer	Temps maximal de traitement du producteur

Figure 47 – Entrée de synchronisation de suréchantillonnage (producteur)

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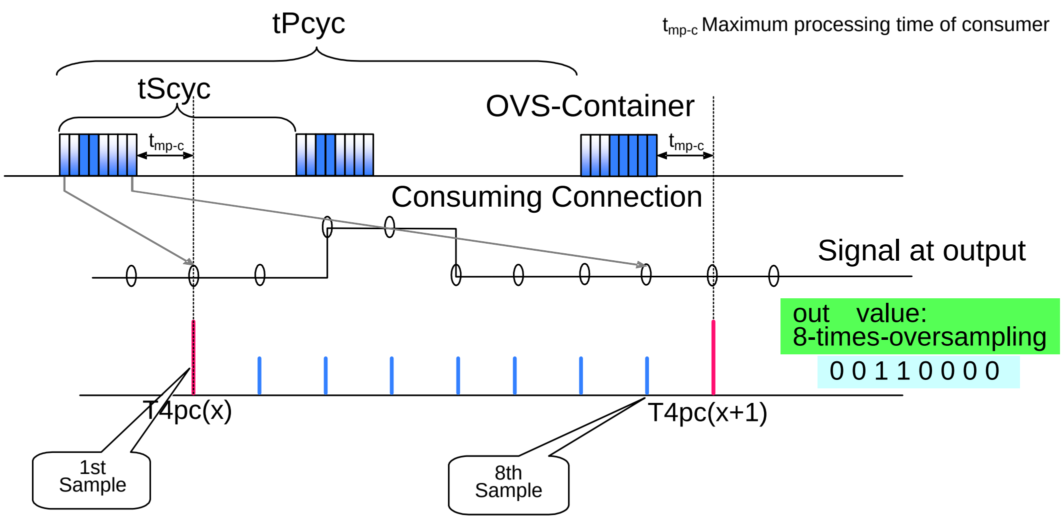
6.8.5 Sortie de suréchantillonnage

Un ou plusieurs signaux constituent une sortie dans un cycle de production (tPcyc) avec une horloge d'échantillonnage plus rapide définie. Les valeurs reçues sont valides dans le cycle de production suivant.

La Figure 48 illustre un exemple de tPcyc de 2 * tScyc et de facteur de suréchantillonnage égal à 8. Le premier point d'échantillonnage est valide à T4pc.



Légende

Anglais	Français
out value: 8-times- oversampling	Valeur de sortie: 8 fois le suréchantillonnage
1st sample	1er échantillon
8th sample	8ème échantillon
Signal at output	Signal en sortie
OVS-container	Conteneur OVS
Consuming connection	Connexion de consommation
Maximum processing time of consumer	Temps maximal de traitement du consommateur

Figure 48 – Sortie de synchronisation de suréchantillonnage (consommateur)

6.8.6 Identification de suréchantillonnage

IDN S-0-1151 avec ses éléments de structure (SE) défini les capacités de suréchantillonnage du groupe de fonctions.

Un domaine de suréchantillonnage est attribué à une instance de structure. Les domaines disponibles sont présentés dans S-0-1152 Nombre de domaines OVS.

- S-0-1151.x.01 Nombre maximal d'échantillons
- S-0-1151.x.02 Résolution interne
- S-0-1151.x.03 Grandeur maximale de cette capacité de suréchantillonnage
- S-0-1151.x.04 Durée d'échantillonnage minimale
- S-0-1151.x.06 IDN configurables de capacité OVS
- S-0-1151.x.07 IDN configurables de capacité OVS - Décalage
- S-0-1151.x.08 IDN configurables de capacité OVS - Longueur

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Tous les éléments de structure du paramètre S-0-1151 sont en lecture seule.

6.8.7 Configuration de suréchantillonnage

Chaque instance de structure (SI) d'IDN S-0-1150 contient la configuration du domaine de suréchantillonnage correspondant.

S-0-1150.x.09 ou Capacité de suréchantillonnage attribuée, affecte l'instance de la capacité de suréchantillonnage dédiée, S-0-1151 Capacités OVS.

Les éléments de structure sont les suivants:

- S-0-1150.x.01 Commande OVS (C-OVS)
- S-0-1150.x.02 Etat OVS (S-OVS)
- S-0-1150.x.03 Conteneur OVS
- S-0-1150.x.04 Durée d'échantillonnage
- S-0-1150.x.05 Déphasage
- S-0-1150.x.06 Liste de configuration OVS - IDN
- S-0-1150.x.07 Liste de configuration OVS - Décalage
- S-0-1150.x.08 Liste de configuration OVS - Longueur
- S-0-1150.x.09 Capacité de suréchantillonnage attribuée
- S-0-1151.x.10 Nombre d'échantillons

6.8.8 Exemple d'application

- Echantillonnage d'entrées rapides (<tPcyc)
- Création de formes de signaux rapides (<tPcyc) à une sortie

Relation entre S-0-1150.x.04 Durée d'échantillonnage et S-0-1150.x.10 Nombre d'échantillons

La configuration des deux IDN peut s'effectuer comme suit:

- Si S-0-1150.x.10 Nombre d'échantillons, est saisi, les données d'exploitation de S-0-1150.x.04 Durée d'échantillonnage, sont calculées par l'esclave selon: S-0-1150.x.04 Durée d'échantillonnage = S-0-1050.x.10 Durée de cycle de production / S-0-1150.x.10 Nombre d'échantillons.
- Si S-0-1150.x.04 Durée d'échantillonnage, est saisi, les données d'exploitation de S-0-1150.x.10 Nombre d'échantillons, sont calculées par l'esclave selon: S-0-1150.x.10 Nombre d'échantillons = S-0-1050.x.10 Durée de cycle de production / S-0-1150.x.04 Durée d'échantillonnage. Le résultat est arrondi s'il n'est pas un entier donné en nanosecondes.
- Si le conteneur OVS correspondant n'a pas été configuré dans une connexion (par exemple pour OVS via SVC), aucun IDN S-0-1050.x.10, pouvant être utilisé pour le calcul de S-0-1150.x.04 n'est disponible. Dans ce cas, Il faut que la configuration de l'automate de suréchantillonnage soit effectuée via S-0-1150.x.04 Durée d'échantillonnage.

6.8.9 Diagramme d'états de suréchantillonnage

La Figure 49 présente le diagramme d'états qui doit être appliqué.

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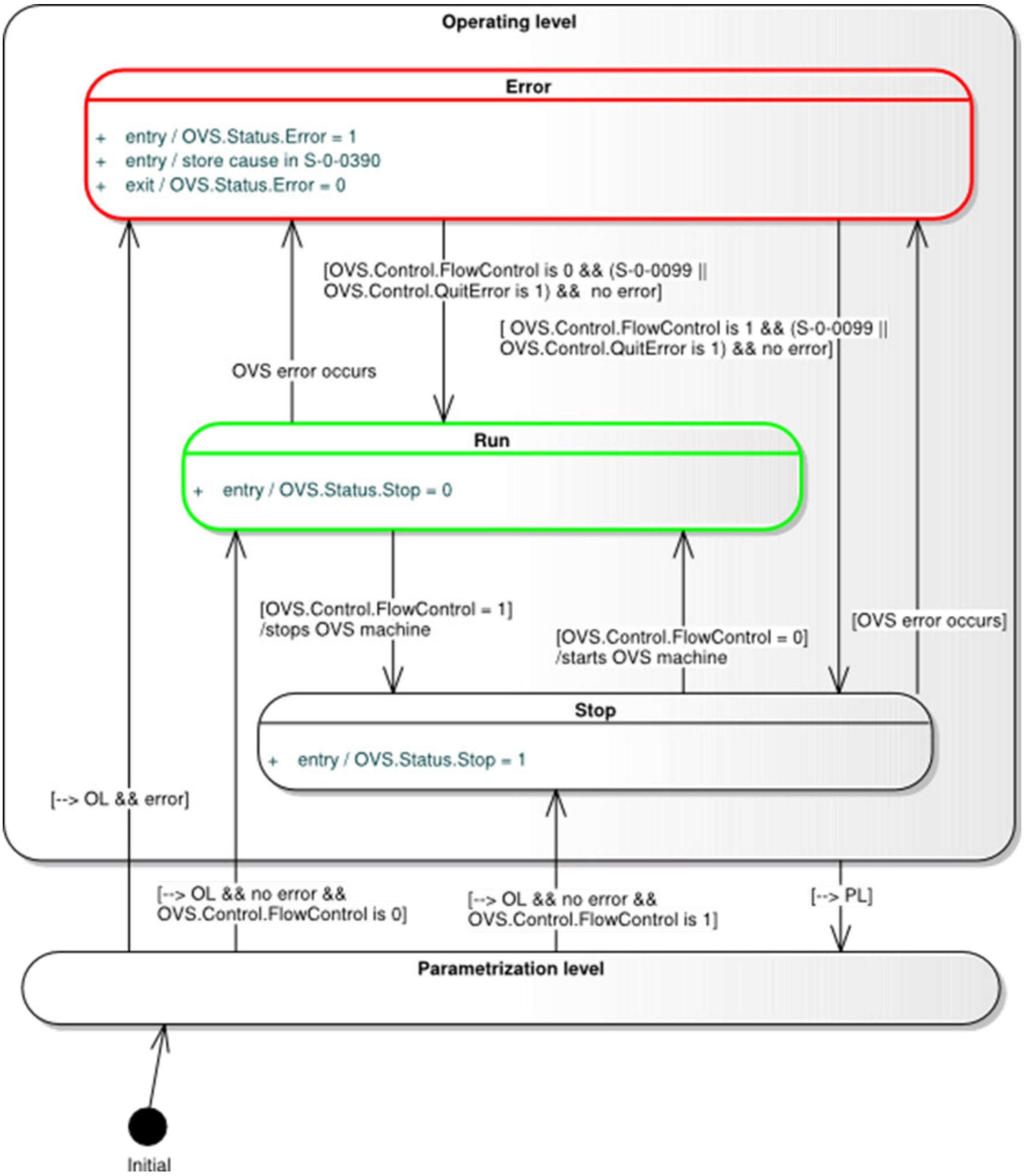

Légende

Anglais	Français
Operating level	Niveau de fonctionnement
Error	Erreur
OVS error occurs	Erreur OVS effective
Run	Exécution
Stops OVS machine	Arrête automate OVS
Starts OVS machine	Démarre automate OVS
Stop	Arrêt
Parametrization level	Niveau de paramétrage

Figure 49 – Diagramme d'états de suréchantillonnage

Les états du diagramme d'états sont décrits dans le Tableau 88.

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Tableau 88 – Etats du diagramme d'états de suréchantillonnage

Etat	Description
Exécution	A cet état, OVS.Status.stop est réglé sur 0. Le diagramme d'états de suréchantillonnage est opérationnel et le reste jusqu'à ce qu'il soit interrompu ou qu'une erreur se produise.
Arrêt	A l'état "Arrêt", le mécanisme OVS est interrompu et OVS.Status.stop est réglé sur 1. Le conteneur d'entrée comporte les derniers échantillons valides (blocage). Les signaux de sortie sont bloqués.
Erreur	En cas d'erreur, les valeurs du conteneur ne sont pas valides. OVS.Status.Error est réglé sur 1 afin d'indiquer cette erreur. Un message de diagnostic 0xC30F4018. doit être généré à l'aide des mécanismes de diagnostic appropriés (S-0-0390).

Les transitions du diagramme d'états sont décrites dans le Tableau 89.

Tableau 89 – Transitions du diagramme d'états de suréchantillonnage

Transition		Description
Source	**Cible**	
Exécution	Arrêt	Si OVS.Control.FlowControl est égal à 1, l'automate de suréchantillonnage s'interrompt et commute sur l'état "Arrêt".
Exécution	Erreur	En cas d'erreur, l'automate de suréchantillonnage s'interrompt et commute sur l'état "Erreur".
Arrêt	Exécution	Si OVS.Control.FlowControl est égal à 0, l'automate de suréchantillonnage démarre et commute sur l'état "Exécution".
Arrêt	Erreur	En cas d'erreur, l'automate de suréchantillonnage commute sur l'état "Erreur".
Erreur	Exécution	Si OVS.Control.QuitError est égal à 1 ou si la commande de procédure S-0-0099 est exécutée et si OVS.Control.FlowControl est égal à 0, et si aucune erreur ne se produit, l'automate de suréchantillonnage redémarre et commute sur l'état "Exécution".
Erreur	Arrêt	Si OVS.Control.QuitError est égal à 1 ou si la commande de procédure S-0-0099 est exécutée et si OVS.Control.FlowControl est égal à 1, et si aucune erreur ne se produit, l'automate de suréchantillonnage commute sur l'état "Arrêt".

7 Temporisation de transmission de télégramme et traitement DLPDU

7.1 Mécanismes de communication

7.1.1 Durée de cycle

La durée de cycle de communication, tScyc, doit avoir l'une des valeurs suivantes:

tScyc = 31,25 µs, 62,5 µs, 125 µs, 250 µs jusqu'à 65 ms (par incréments de 250 µs)

Cette durée de cycle peut comporter une certaine instabilité. L'instabilité décrit les écarts par rapport à la valeur tScyc dans la distance entre deux MST.

Par conséquent, l'intervalle de temps réel entre la fin d'un MST et la fin du MST suivant doit avoir une

- valeur minimale de j x tScyc × 0,999 9 + JtScyc (j = 1, 2, 3, ...) et une
- valeur maximale de j x tScyc × 1,000 1 + JtScyc (j = 1, 2, 3, ...)

NOTE j est un nombre entier ordinaire et n'est pas lié aux abréviations.

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Les facteurs 0,999 9 et 1,000 1 tiennent compte de l'écart de la durée de cycle de communication S-0-1002 (tScyc), par rapport à la précision des oscillateurs à quartz habituels (± 50 $\mu Hz/Hz$). L'instabilité ne doit pas se cumuler sur plusieurs périodes (c'est-à-dire que la valeur moyenne doit être égale à zéro).

7.1.2 Accès au support

7.1.2.1 Définitions de la temporisation de communication

Les calculs de temporisation d'un réseau de Type 19 sont fondés sur une vitesse de transmission de 100 Mbit/s.

Pendant la phase d'initialisation, le maître doit exiger des esclaves qu'ils fournissent les paramètres temporels (voir phase de communication 2 (CP2). Avec cette information, le maître doit calculer les créneaux de transmission sans chevauchement des télégrammes de Type 19 dans le canal RT.

Le maître doit transmettre à chaque esclave le temps de début de transmission S-0-1006 AT0 (t1), ainsi que les temps de début et de fin du canal UC, t6 et t7 (S-0-1017 UC temps de transmission), respectivement. Ces temps de début applicables aux créneaux de transmission des télégrammes sont définis ci-dessous, tandis que les instabilités et les retards ont été intégrés à cette temporisation.

canal RT ≈ bloc MDT + bloc AT

Pour une communication sans chevauchement dans le canal RT, les paramètres suivants doivent être pris en compte lors du calcul par le maître de la temporisation associée (voir Tableau 90).

Tableau 90 – Paramètre pour le calcul de la temporisation

Paramètre	Description
TTref[ns]	Dans le texte ci-dessous, toutes les temporisations se rapportent à la "fin du MST" appelée TTref (voir Figure 50). Celle-ci est définie comme la dernière durée limite de CRC MST.
tTH[ns]	l'en-tête de télégramme (tTH) définit le retard entre le début du préambule et la fin du MST (TTref) et représente une durée constante de 2240 ns (28 octets).
Instabilité MST[ns]	Selon les performances du matériel, le maître envoie le MST (bloc MD) avec une instabilité. L'instabilité MST fait partie intégrante de l'instabilité SYNC ou S-0-1023.
instabilité t1[ns]	Selon les performances du matériel, le maître envoie l'AT0 (bloc AT) avec une instabilité.
Instabilité de l'esclave[ns]	L'interface (matériel) de l'esclave produit l'instabilité de télégramme définie dans S-0-1037 Instabilité de l'esclave.
Espace entre trames (IFG)[octets]	L'IFG définit la distance entre deux trames Ethernet. La spécification Ethernet requiert au minimum 12 octets. L'espace entre trames dépend du nombre de participants à la topologie. Le maître doit utiliser la formule de l'IFG pour calculer S-0-1036 Espace entre trames pour l'application donnée.
tIFG[ns]	correspond à l'espace entre trames des octets convertis en temps (ns).
instabilité IFG[ns]	correspond à tIFG – 960 ns (12 octets). L'instabilité IFG fait partie intégrante de l'instabilité SYNC ou S-0-1023.
bloc MDT[ns]	Période de tous les MDT utilisés avec les espaces entre trames correspondants.
bloc AT[ns]	Période de tous les AT utilisés avec les espaces entre trames correspondants.

Les paramètres de temporisation de la communication doivent être définis par le maître en CP2 et activés dans le maître et les esclaves en CP3 et CP4.

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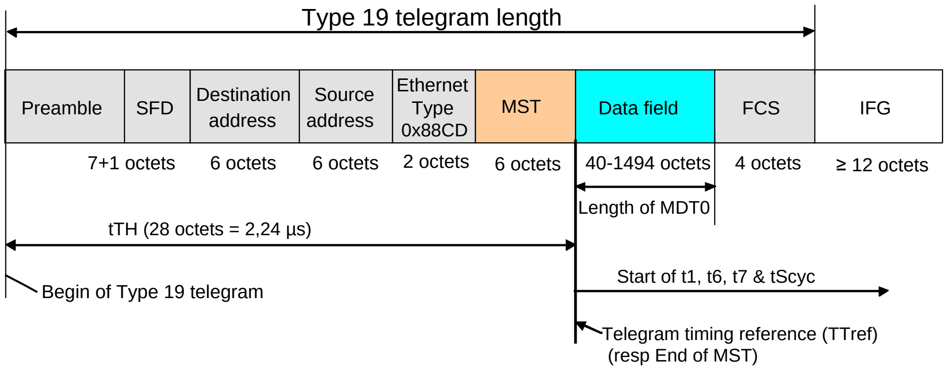

Légende

Anglais	Français
Type 19 telegram length	Longueur de télégramme de Type 19
Preamble	Préambule
Destination address	Adresse de destination
Source address	Adresse source
Ethernet type	Type Ethernet
Data field	Champ de données
Length of MDT0	Longueur de MDT0
Begin of Type 19 telegram	Début de télégramme de Type 19
Start of t1, t6, t7 & tScyc	Démarrage de t1, t6, t7 & tScyc
Telegram timing reference	Référence de temporisation de télégramme
(resp End of MST)	(par rapport à la fin de MST)

Figure 50 – Référence de temporisation de télégramme

7.1.3 Calcul de la longueur d'un télégramme de Type 19

Le calcul de la longueur d'un télégramme de Type 19 inclut les champs de télégrammes suivants présentés à la Figure 51:

- Préambule + SFD (7 + 1 octets)
- Adresse de destination (6 octets)
- Adresse source (6 octets)
- Type Ethernet (2 octets)
- En-tête de Type 19 (6 octets)
- Séquence de contrôle de trame (4 octets)

--> L'en-tête total d'un télégramme de Type 19 contient 32 octets.

- Champ de données (40 à 1494 octets)

Longueurs et périodes de télégrammes minimales et maximales:

- La longueur minimale d'un télégramme de Type 19 contient 72 octets (32 octets + 40 octets), entraînant une période de télégramme de 5,8 µs.
- La longueur maximale d'un télégramme de Type 19 contient 1526 octets (32 octets + 1494 octets), entraînant une période de télégramme de 122,1 µs.

Une période de télégramme SIII individuelle est calculée comme suit:

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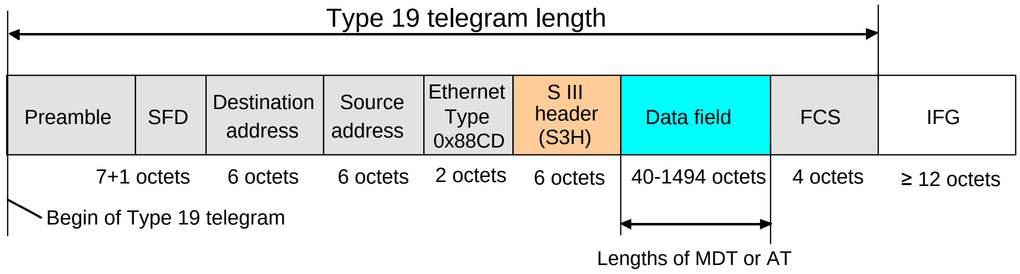
- Période de télégramme de Type 19 (µs) = Longueur de télégramme de Type 19 (octets) * 8 (bit) * 0,01 (µs)



Légende

Anglais	Français
Type 19 telegram length	Longueur de télégramme de Type 19
Preamble	Préambule
Destination address	Adresse de destination
Source address	Adresse source
Ethernet type	Type Ethernet
Data field	Champ de données
S III header	en-tête S III
Lengths of MDT or AT	Longueurs de MDT ou AT
Begin of Type 19 telegram	Début de télégramme de Type 19

Figure 51 – Calcul de la longueur de télégramme

7.1.4 Calcul de la temporisation du canal RT

Le maître doit tout d'abord calculer la durée du canal RT, puis il peut calculer le créneau du canal UC.

Le maître doit effectuer les calculs suivants:

- bloc MDT = somme des périodes de télégramme de Type 19 de tous les MDT utilisés + nombre de MDT * tIFG (voir S-0-1036 Espace entre trames).
- bloc AT = somme des périodes de télégramme de Type 19 de tous les AT utilisés + nombre d'AT * tIFG (voir S-0-1036 Espace entre trames).
- le maître calcule les temps t1min et t1max avec la durée de cycle de communication et les blocs MDT et AT.
- il doit déterminer le temps t1 compte tenu de t1min, t1max et tScyc.
- S-0-1006 Temps de début de transmission AT0 (t1): il s'agit de l'intervalle de temps nominal entre la fin de MST et le début de AT0. Ce paramètre doit être déterminé par le maître et archivé dans les esclaves associés.
- S-0-1017 Temps de transmission NRT: début du canal UC (t6) et fin du canal UC (t7). Le canal UC ne doit comporter aucun créneau spécial. Chaque participant doit être capable de transmettre ses trames Ethernet pendant ce créneau.
- S-0-1023 InsCtabilité SYNC: calculé par le maître en utilisant l'instabilité MST et l'instabilité IFG. Ce paramètre est transmis aux esclaves en phase CP2.
- Formule de S-0-1036 Espace entre trames:

$$S-0-1036 \geq \frac{27*(S-0-1037)_{MAX}*\sqrt{2*N}}{8000} * \frac{1\text{octet}}{0{,}08\mu s} + 12\text{octets}$$

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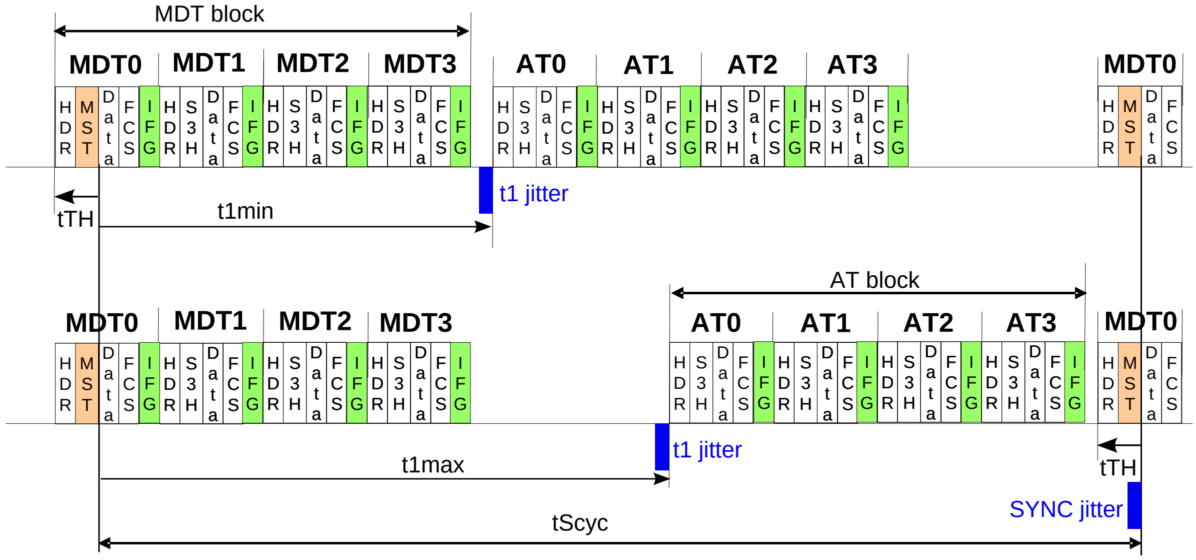
NOTE N est le nombre de participants à la topologie.

7.1.5 Calcul du temps de début de transmission de AT0 ou S-0-1006 (t1)

Le maître doit calculer le temps minimal de t1 (t1min) et le temps maximal de t1 (t1max) compte tenu de S-0-1002 Durée de cycle de communication (tScyc).

- t1min = bloc MDT + (instabilité t1) - tTH
- t1max = tScyc - bloc AT - tTH - instabilité t1 - (instabilité SYNC)
- si t1max < t1min, le maître doit alors utiliser un tScyc plus long ou réduire le nombre de données dans les télégrammes de Type 19.
- t1min ≤ S-0-1006 ≤ t1max

La Figure 52 illustre la temporisation de t1 potentielle en CP3 et CP4.



Légende

Anglais	Français
MDT block	Bloc MDT
T1 jitter	Instabilité t1
AT block	Bloc AT
SYNC jitter	Instabilité SYNC
Data	Données

Figure 52 – Calcul de t1

NOTE

- instabilité t1 = instabilité de transmission de AT0
- instabilité MST = instabilité de transmission de MDT0
- instabilité Sync = instabilité SYNC ou S-0-1023
- HDR= En-tête Ethernet
- MST = En-tête de Type 19 de MDT0
- S3H = En-tête de Type 19 de MDT1 à MDT3 et AT0 à AT3
- Données = Charge utile
- FCS = Séquence de contrôle de trame
- IFG = S-0-1036 Espace entre trames

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- tTH = en-tête de télégramme de Type 19
- bloc MDT = Période de tous les MDT transmis
- bloc AT = Période de tous les AT transmis

7.1.6 Calcul de la temporisation du canal UC

Le maître doit calculer le temps S-0-1017 temps de transmission NRT (t6 et t7) pour la méthode 1 ou 2, compte tenu des paramètres t1 et tScyc.

Il convient de régler la durée du canal UC la plus longue possible.

Calcul pour la méthode 1 (m1):

- Le temps t6 (début du canal UC) doit être calculé comme suit: t6.m1 = t1 + (instabilité t1) + bloc AT (instabilité t1 = t1_transmit_jitter + instabilité IFG)
- Le temps t7 (fin du canal UC) doit être calculé comme suit: t7.m1 = tScyc - (instabilité SYNC) - tTH
- Le maître doit régler le temps t6 le plus court possible --> t6 ≥ t6.m1
- Le maître doit régler le temps t7 le plus long possible --> t7 ≥ t7.m1

Calcul pour la méthode 2 (m2)

- Le temps t6 (début du canal UC) doit être calculé comme suit: t6.m2 = bloc MDT - tTH (+ instabilité)
- Le temps t7 (fin du canal UC) doit être calculé comme suit: t7.m2 = (instabilité t1)
- Le maître doit régler le temps t6 le plus court possible --> t6 ≥ t6.m2
- Le maître doit régler le temps t7 le plus long possible --> t7 ≤ t7.m2

Limites du canal UC en CP3 et CP4

- La durée minimale du canal UC = (t7 - t6) ≥ 5,8 μs + tIFG (0,96 μs)

La Figure 53 présente le calcul de t6 et t7 pour les méthodes 1 et 2 utilisées en CP3 et CP4.

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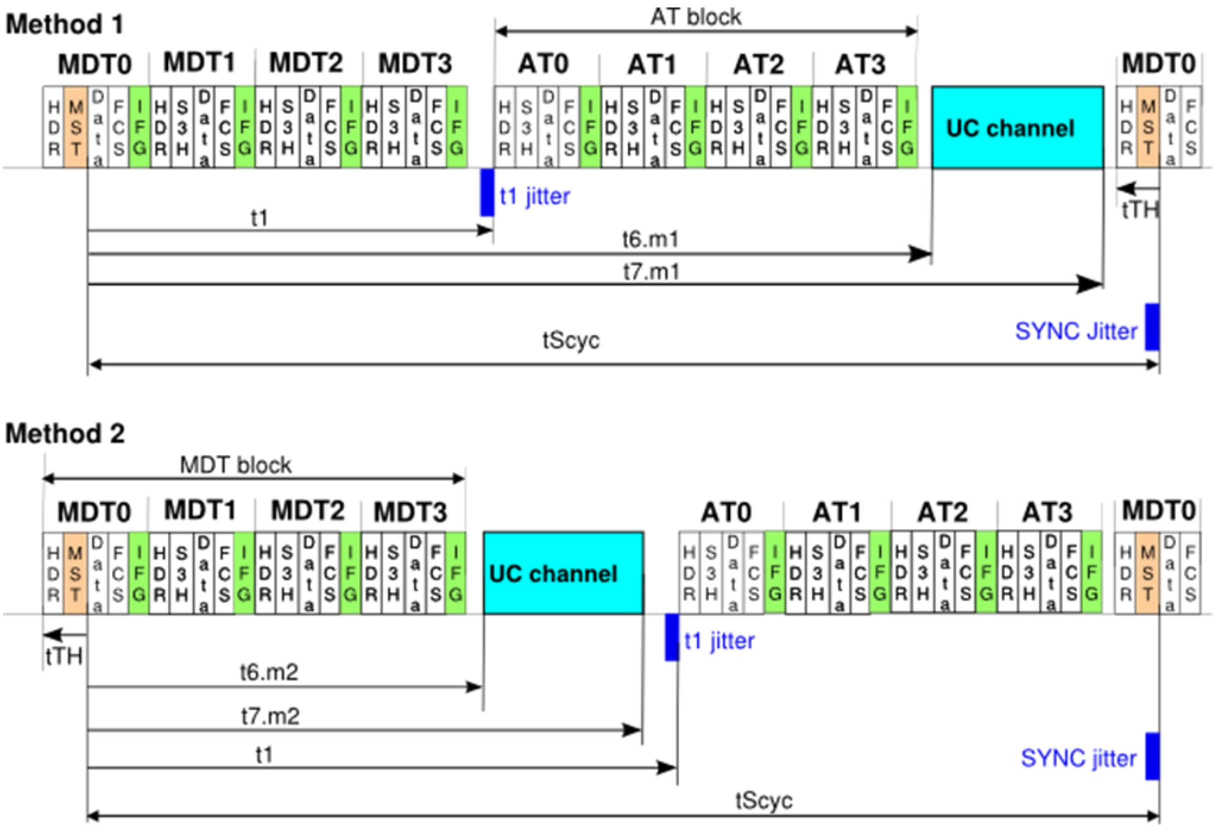

Légende

Anglais	Français
Method 1	Méthode 1
T1 jitter	Instabilité t1
AT block	Bloc AT
SYNC jitter	Instabilité SYNC
UC channel	Canal UC
Method 2	Méthode 2
MDT block	Bloc MDT
Data	Données

Figure 53 – Détermination du canal UC

7.1.7 Temporisation des télégrammes en phase CP0

La durée de cycle de communication doit être prédéfinie par le maître avec une marge de 1 ms ≤ tScyc-cp0 ≤ 65 ms. La temporisation des télégrammes en phase CP0 est présentée à la Figure 54. Aucun temps de transmission n'est spécifié pour AT0, mais il doit être transféré après MDT0 et avant que le canal UC ne soit activé (le temps t6cp0 est atteint).

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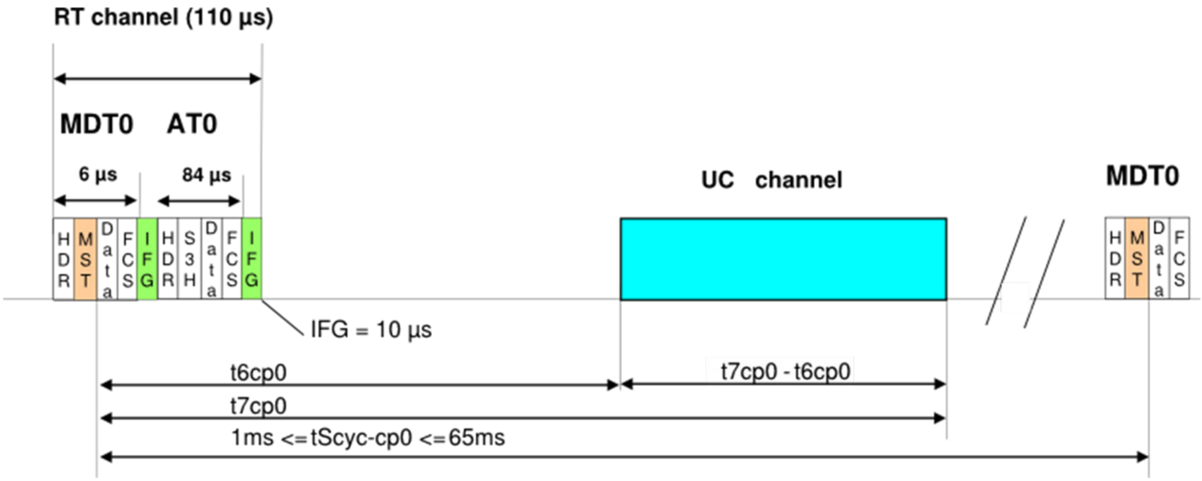

Légende

Anglais	Français
RT channel	Canal RT
UC channel	Canal UC
Data	Données

Figure 54 – Diagramme de temporisation en phase CP0

Les valeurs par défaut de la temporisation en phase CP0 sont définies dans le Tableau 91.

7.1.8 Temporisation des télégrammes en phases CP1 et CP2

Quatre configurations de télégramme sont possibles en phases CP1 et CP2. Deux configurations ont une durée minimale de cycle de communication de 1 ms et peuvent adresser jusqu'à 255 esclaves (cas 1 et 3); les autres configurations ont une durée minimale de cycle de communication de 2 ms et peuvent adresser jusqu'à 511 esclaves (cas 2 et 4). Un espace entre trames de 10 µs est utilisé pour toutes les configurations de télégrammes.

- Cas 1 (jusqu'à 255 esclaves): La durée de cycle de communication doit être prédéfinie par le maître avec une marge de 1 ms ≤ tScyc-cp1/2 ≤ 65 ms. La séquence de télégrammes en phases CP1 et CP2 est présentée à la Figure 55. Aucun temps de transmission n'est défini pour MDT1, AT0 et AT1, mais leur transfert doit s'effectuer intégralement dans cet ordre avant l'écoulement du temps t6cp1/2 (début du canal UC en CP1&2). Le maître doit envoyer le MDT0 suivant après l'écoulement du temps t7cp1/2. Le maître peut annoncer la transmission des paramètres de temporisation de CP1/2 dans la version de communication. Si l'esclave prend en charge cette fonctionnalité, il doit alors l'acquitter en définissant bit 15 = 1 de l'index de topologie dans l'AT0 de la phase CP0. Lorsque le maître n'a pas transmis les paramètres de temporisation de CP1/2 dans le MDT0 de la phase CP0 ou l'esclave n'a pas évalué ou ne peut pas accepter ces paramètres, il ne doit alors pas l'acquitter en définissant bit 15 = 0 de l'index de topologie dans l'AT0 de la phase CP0. Par conséquent, les valeurs par défaut de CP1/2 doivent être activées dans le maître et les esclaves (voir Tableau 91).

Tableau 91 – Valeurs par défaut de CP1/2 (cas 1)

Paramètre	Valeur par défaut
t6cp1/2	650 µs
t7cp1/2	950 µs

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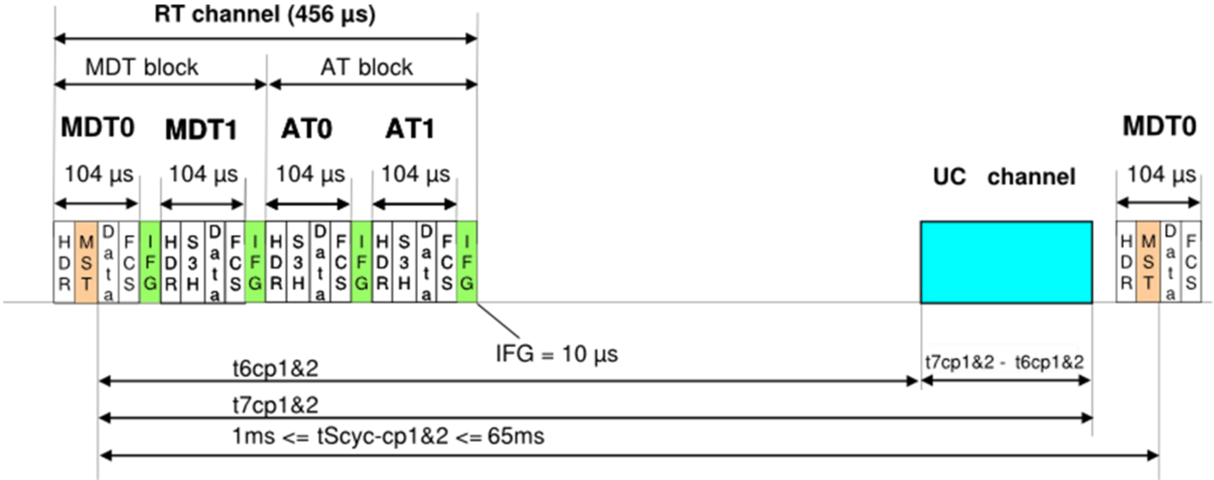

Légende

Anglais	Français
RT channel	Canal RT
UC channel	Canal UC
MDT block	Bloc MDT
AT block	Bloc AT
Data	Données

Figure 55 – Diagramme de temporisation des phases CP1 et CP2 avec 2 MDT, 2AT et canal UC

- Cas 2 (jusqu'à 511 esclaves): La durée de cycle de communication doit être prédéfinie par le maître avec une marge de 2 ms ≤ tScyc-cp1/2 ≤ 65 ms. La séquence de télégrammes en phases CP1 et CP2 est présentée à la Figure 56. Aucun temps de transmission n'est défini pour MDT1, MDT2, MDT3, AT0, AT1, AT2 et AT3, mais leur transfert doit s'effectuer intégralement dans cet ordre avant l'écoulement du temps t6cp1/2 (début du canal UC).Le maître doit envoyer le MDT0 suivant après l'écoulement du temps t7cp1/2. Le maître peut annoncer la transmission des paramètres de temporisation de CP1/2 dans la version de communication. Si l'esclave prend en charge cette fonctionnalité, il doit alors l'acquitter en définissant bit 15 = 1 de l'index de topologie dans l'AT0 de la phase CP0. Lorsque le maître n'a pas transmis les paramètres de temporisation de CP1/2 dans le MDT0 de la phase CP0 ou l'esclave n'a pas évalué ou ne peut pas accepter ces paramètres, il ne doit alors pas l'acquitter en définissant bit 15 = 0 de l'index de topologie dans l'AT0 de la phase CP0. Par conséquent, les valeurs par défaut de CP1/2 doivent être activées dans le maître et les esclaves (voir Tableau 92).

Tableau 92 – Valeurs par défaut de CP1/2 (cas 2)

Paramètre	Valeur par défaut
t6cp1/2	1050 µs
t7cp1/2	1950 µs

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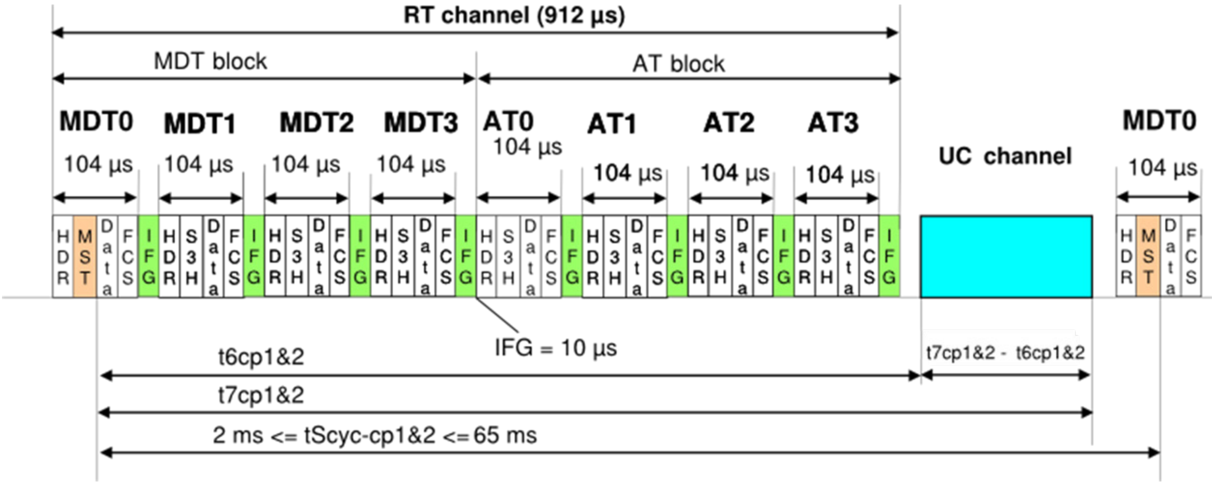

Légende

Anglais	Français
RT channel	Canal RT
UC channel	Canal UC
MDT block	Bloc MDT
AT block	Bloc AT
Data	Données

Figure 56 – Diagramme de temporisation des phases CP1 et CP2 avec 4 MDT, 4 AT et canal UC

- Cas 3 (jusqu'à 255 esclaves): La durée de cycle de communication doit être prédéfinie par le maître avec une marge de 1 ms ≤ tScyc-cp1/2 ≤ 65 ms. La séquence de télégrammes en phases CP1 et CP2 est présentée à la Figure 57. Le temps de transmission de AT0 (t1cp1/2) est défini. Aucun temps de transmission n'est défini pour MDT1 et AT1. Le transfert de MDT1 doit s'effectuer dans cet ordre avant l'écoulement du temps t6cp1/2 (début du canal UC en CP1&2). Le transfert de AT1 doit s'effectuer dans cet ordre avant le début de la transmission du MDT0 suivant. Par conséquent, le maître doit envoyer le MDT0 suivant après la fin de l'AT1. Le maître peut annoncer la transmission des paramètres de temporisation de CP1/2 dans la version de communication. Si l'esclave prend en charge cette fonctionnalité, il doit alors l'acquitter en définissant bit 15 = 1 de l'index de topologie dans l'AT0 de la phase CP0. Lorsque le maître n'a pas transmis les paramètres de temporisation de CP1/2 dans le MDT0 de la phase CP0 ou l'esclave n'a pas évalué ou ne peut pas accepter ces paramètres, il ne doit alors pas l'acquitter en définissant bit 15 = 0 de l'index de topologie dans l'AT0 de la phase CP0. Par conséquent, les valeurs par défaut de CP1/2 doivent être activées dans le maître et les esclaves (voir Tableau 91).

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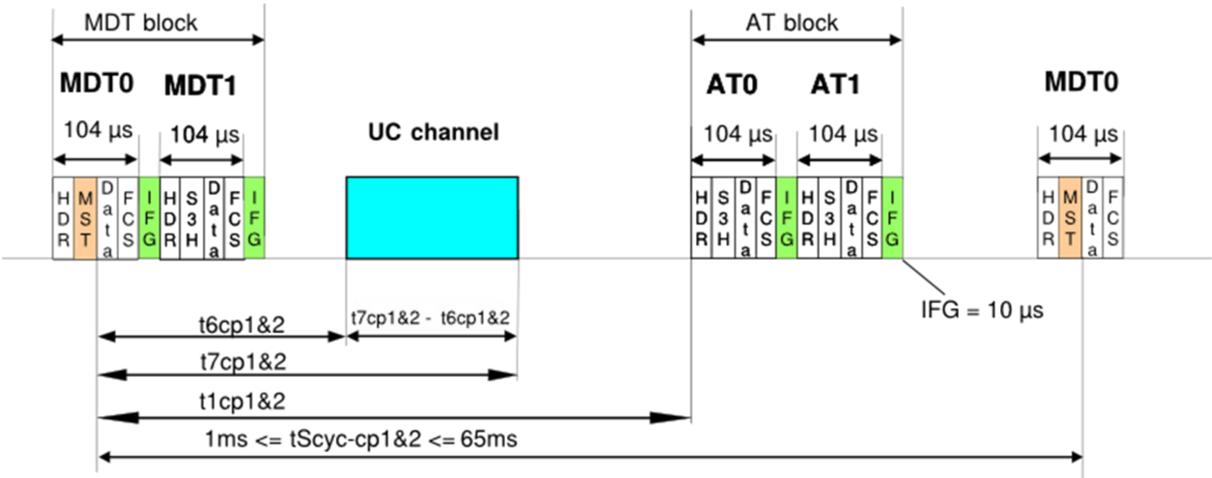

Légende

Anglais	Français
UC channel	Canal UC
MDT block	Bloc MDT
AT block	Bloc AT
Data	Données

Figure 57 – Diagramme de temporisation des phases CP1 et CP2 avec 2 MDT Canal UC et 2 AT

- Cas 4 (jusqu'à 511 esclaves): La durée de cycle de communication doit être prédéfinie par le maître avec une marge de 2 ms ≤ tScyc-cp1/2 ≤ 65 ms. La séquence de télégrammes en phases CP1 et CP2 est présentée à la Figure 58. Le temps de transmission de AT0 (t1cp1/2) est défini. Aucun temps de transmission n'est défini pour MDT1, MDT2 et MDT3, mais leur transfert doit s'effectuer intégralement dans cet ordre avant l'écoulement du temps t6cp1/2 (début du canal UC). Aucun temps de transmission n'est défini pour AT1, AT2, AT3, mais leur transfert doit s'effectuer dans cet ordre avant le début de la transmission du MDT0 suivant. Par conséquent, le maître doit envoyer le MDT0 suivant après la fin de AT1. Le maître doit annoncer la transmission des paramètres de temporisation de CP1/2 dans la version de communication. Si l'esclave prend en charge cette fonctionnalité, il doit alors l'acquitter en définissant bit 15 = 1 de l'index de topologie dans l'AT0 de la phase CP0. Lorsque le maître n'a pas transmis les paramètres de temporisation de CP1/2 dans le MDT0 de la phase CP0 ou l'esclave n'a pas évalué ou ne peut pas accepter ces paramètres, il ne doit alors pas l'acquitter en définissant bit 15 = 0 de l'index de topologie dans l'AT0 de la phase CP0. Par conséquent, les valeurs par défaut de CP1/2 (cas 2) doivent être activées dans le maître et les esclaves (voir Tableau 92).

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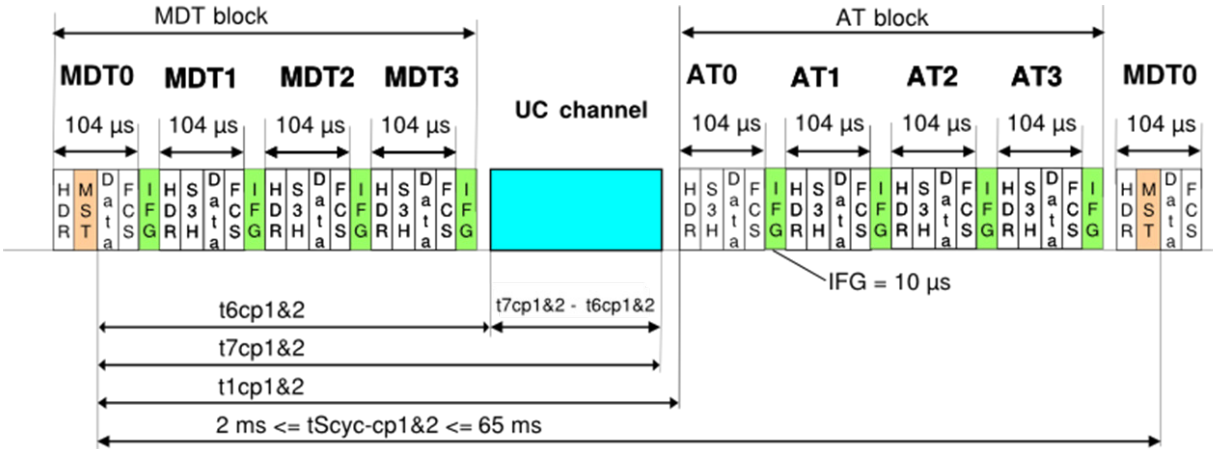

Légende

Anglais	Français
UC channel	Canal UC
MDT block	Bloc MDT
AT block	Bloc AT
Data	Données

Figure 58 – Diagramme de temporisation des phases CP1 et CP2 avec 4 MDT, canal UC et 4 AT

7.1.9 Temporisation de télégrammes en phases CP3 et CP4

La séquence des télégrammes de Type 19 et des télégrammes UC transmis doit être répétée à chaque cycle de communication. Les créneaux propres aux canaux RT et UC, et le temps de transmission du télégramme AT, doivent être transmis pendant l'initialisation et sont par conséquent connus par chaque esclave. La Figure 59 illustre les deux dispositions possibles des canaux RT et UC. Le maître doit toujours utiliser une méthode parmi ces deux méthodes, dont le choix dépend de la configuration.

NOTE Certaines unités de commande calculent les nouvelles valeurs de commande uniquement après réception de toutes les valeurs de retour. Le temps disponible pour le calcul des valeurs de commande est plus important dans la méthode 1. La méthode 2 est toutefois plus appropriée pour la commande de position dans la mesure où l'unité de commande peut calculer les nouvelles valeurs de commande tout en continuant à recevoir les valeurs de retour.

Un contrôle d'accès au support sans chevauchement synchrone doit être utilisé dans le canal RT. Des télégrammes doivent être échangés dans des cycles de communication fixes. Le maître doit entamer le cycle de communication à stricte équidistance de la durée de cycle de communication tScyc, par transmission du télégramme MDT0. Le cycle de communication suivant doit démarrer avec la transmission du MDT0 suivant. Le cycle de communication est défini entre la fin du MST du cycle de communication (n) et la fin du MST du cycle de communication suivant (n+1).

Les télégrammes MDT (MDT0 à MDT3) doivent être transmis à tous les esclaves. Le MDT0 doit contenir l'information de synchronisation et l'état de la communication dans le champ MST.

Les télégrammes AT (AT0 à AT3) doivent être transmis par le maître avec la longueur de télégramme configurée, le champ de données étant toutefois rempli de zéros. Chaque esclave doit intégrer ses données en temps réel dans le champ de données qui lui est attribué dans les AT. La séquence des champs de données des esclaves dans les télégrammes AT doit être indépendante de l'ordre physique de la topologie, ainsi que de l'adresse de sous-appareil prédéfinie. Le maître doit être le destinataire final des AT.

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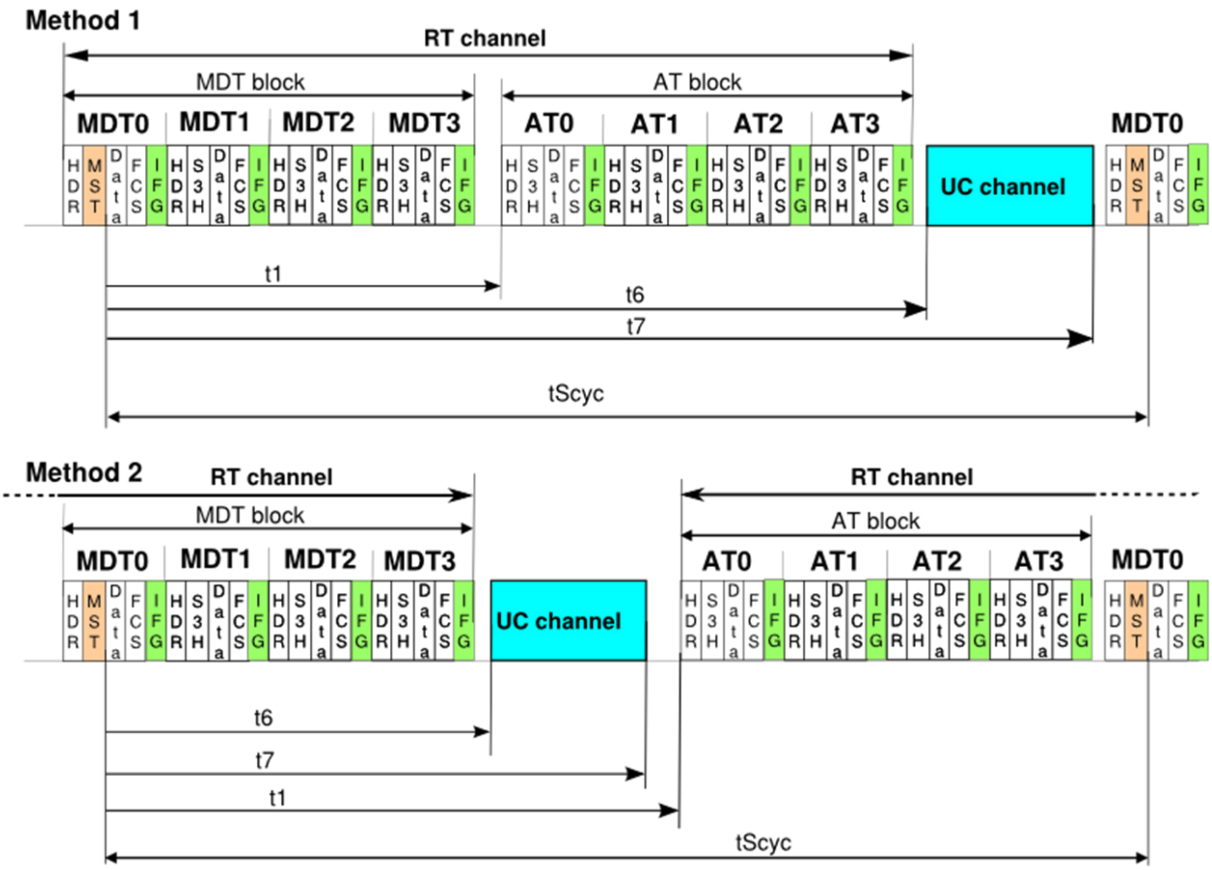
La longueur du champ de données et la signification du contenu de l'en-tête MST et AT doivent rester constantes et être ainsi identiques à chaque cycle de communication.

Chaque appareil de Type 19 peut envoyer ses télégrammes UC dans le canal UC.



Légende

Anglais	Français
Method 1	Méthode 1
RT channel	Canal RT
UC channel	Canal UC
MDT block	Bloc MDT
AT block	Bloc AT
Communication cycle	Cycle de communication
Method 2	Méthode 2
Data	Données

Figure 59 – Séquence de télégrammes

7.1.10 Mécanismes de communication NRT

7.1.10.1 Introduction

Avant initialisation de la communication en temps réel de Type 19, la communication avec les esclaves doit utiliser des mécanismes IP standard si elle prend en charge cette fonction. Dès le lancement ou la réalisation de l'initialisation, une communication IP doit être possible uniquement dans le canal UC.

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Dans le canal UC (créneau entre t_6 et t_7), les participants doivent transmettre toute sorte de télégrammes UC sur un port selon l'adresse MAC de destination de trames. Si les appareils de réseau de Type 19 n'ont pas encore identifié le bon port, ils doivent transmettre les télégrammes UC sur les deux ports.

Le temps t6 marque le début et le temps t7 marque la fin du canal UC par rapport à la fin de MST (En-tête de Type 19 de MDT0 par rapport au temps TTref).

Dans les phases CP0, CP1 et CP2, le créneau entre t6 et t7 est disponible uniquement si l'esclave reçoit un MST valide. Dans le cas contraire, la communication NRT n'est pas possible dans ce cycle de communication.

Chaque transmission d'un télégramme UC doit être annulée au temps t7.

Les télégrammes UC peuvent être acheminés soit immédiatement, ou ultérieurement selon la charge de communication.

Les télégrammes de Type 19 doivent être interrompus à réception du temps TTref (fin de l'en-tête de Type 19) entre t6 et t7.

Le bouclage avec acheminement ne doit jamais être actif lorsque le canal UC est actif, même si un appareil de Type 19 détecte une interruption de transmission et devient le dernier participant dans une configuration linéaire.

Dans les phases CP0, CP1 et CP2, la temporisation du canal UC est définie avec les valeurs par défaut. Dans les phases CP3 et CP4, le canal UC peut être positionné avant ou après les AT. La Figure 60 illustre ces deux positions.

La méthode de calcul d'un créneau valide défini par t6 et t7 (S-0-1017), ainsi que la signification de t1, tTH, etc. sont décrites en 7.1.2. Le canal UC peut être désactivé en réglant le temps t6 sur 0. Dans ce cas, la mémoire tampon de collision doit être aussi désactivée dans le maître et les esclaves. Ceci doit empêcher que les télégrammes UC soient enregistrés dans la mémoire tampon de collision.

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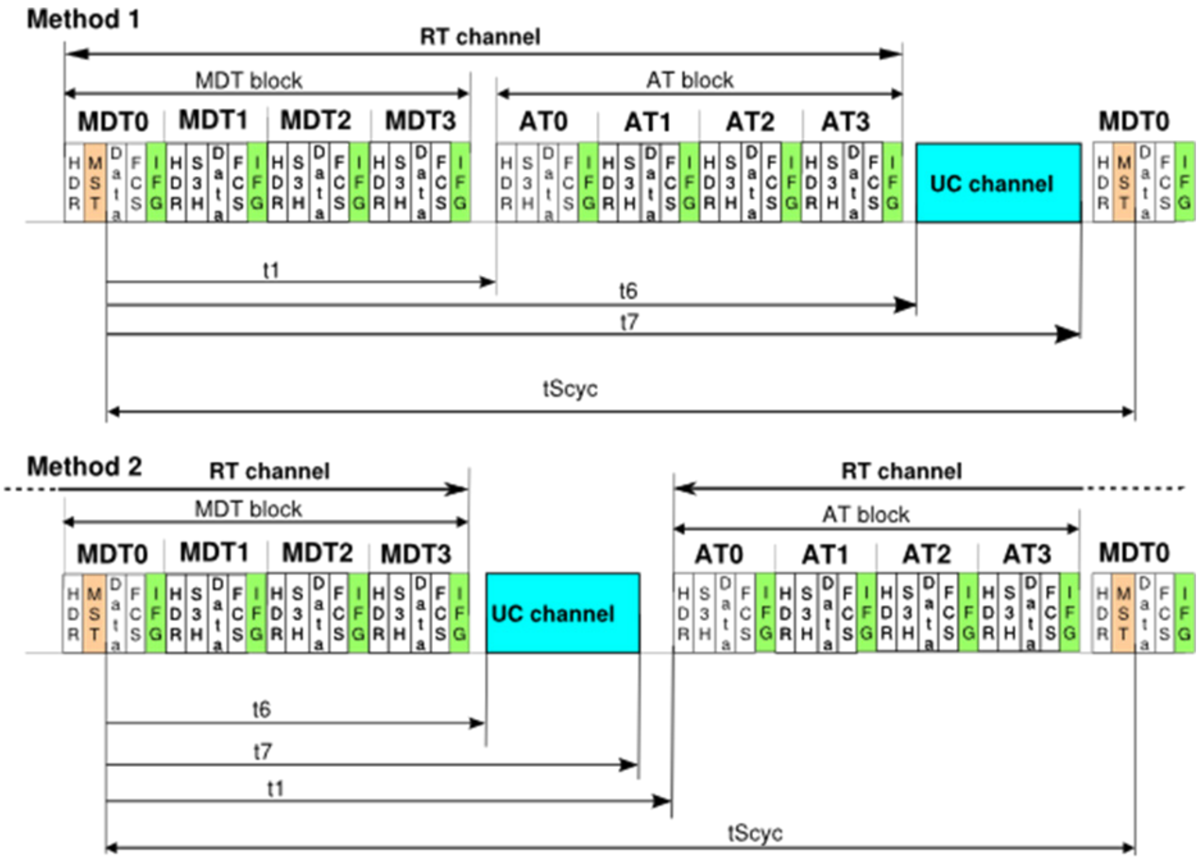

Légende

Anglais	Français
Method 1	Méthode 1
T1 jitter	Instabilité t1
UC channel	Canal UC
MDT block	Bloc MDT
AT block	Bloc AT
Communication cycle	Cycle de communication
Method 2	Méthode 2
SYNC jitter	Instabilité SYNC
Data	données

Figure 60 – Deux positions définies du canal UC

- Envoi des télégrammes UC:
  - Premier transmis: Le premier télégramme UC doit être envoyé dans le canal UC au plus tôt dans un délai de 80 ns après écoulement du temps T6 (début de canal UC). --> Premier transmis = T6 + 80 ns (voir Figure 61)
  - Dernier transmis: Le dernier télégramme UC doit être envoyé dans le canal UC au plus tard avant le temps T7 (fin du canal UC) compte tenu des conditions suivantes. --> Dernier transmis = T7 - période de télégramme IP - commutation du canal UC au canal RT (tHW) - IFG (voir Figure 61)
    - La période du télégramme UP (avec préambule, DA, SA, type/longueur, charge utile et FCS),
    - la durée nécessaire à l'appareil de Type 19 pour commuter du canal UC au canal RT (tHW) et
    - l'IFG avec 12 octets (tIFG = 960 ns).

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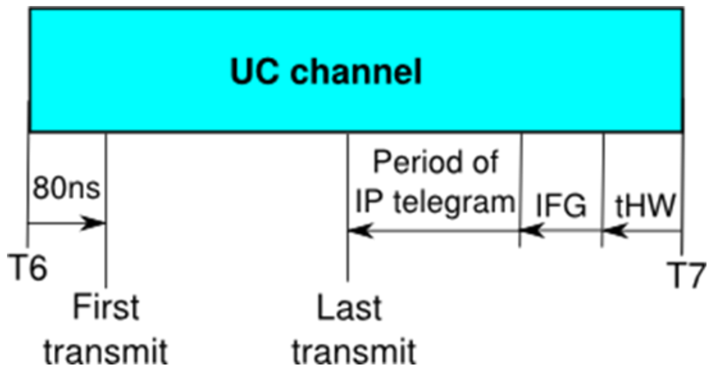
– Après T7 (fin du canal UC), l'appareil de Type 19 doit être capable de traiter les trames RT (télégrammes de Type 19) immédiatement.

- Réception des télégrammes UC: La réception des télégrammes UC doit être possible entre T6 et T7 dans un appareil de Type 19.



Légende

Anglais	Français
UC channel	Canal UC
Period of IP telegram	Période de télégramme IP
First transmit	Premier transmis
Last transmit	Dernier transmis

Figure 61 – Premier et dernier transmis dans le canal UC

7.1.10.2 Esclaves sur une ligne ou un anneau

Lorsqu'un esclave reçoit un télégramme lorsque le canal UC est actif et transmet une trame Ethernet, la trame Ethernet actuellement transmise ne doit pas être interrompue et le télégramme entrant doit être archivé dans toute la mesure du possible.

Les esclaves doivent toujours transmettre leurs propres trames Ethernet sur un port (P1 ou P2) selon l'adresse MAC de destination, à condition que toutes les conditions suivantes soient satisfaites avant ladite transmission:

- l'esclave n'est pas déjà en train d'acheminer un autre télégramme, dans le cas contraire, il doit attendre l'acheminement complet de ce télégramme;
- la durée restante du canal UC est suffisante pour transmettre entièrement sa propre trame Ethernet;
- sa mémoire a une capacité libre suffisante pour archiver au moins une nouvelle trame Ethernet entrante de longueur maximale.

Si les esclaves n'ont pas encore identifié le bon port, ils doivent transmettre la trame sur les deux ports.

7.1.10.3 Esclave en dernière position sur une ligne

Bien que le bouclage avec acheminement du dernier esclave présent sur une ligne (voir Structure linéaire et bouclage avec acheminement) soit actif, ledit esclave doit vérifier toute trame Ethernet entrante présente sur son port inactif. Le dernier esclave doit acheminer les trames Ethernet lorsque son canal UC est actif, à condition que la durée restante de ce canal UC soit suffisante pour transmettre cette trame Ethernet dans son intégralité. Il doit également acheminer toutes les trames Ethernet entrantes de type "autre que le Type 19" dès que le canal UC est de nouveau actif, à condition que la durée restante de ce nouveau canal UC soit suffisante.

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Le dernier esclave d'une topologie linéaire doit utiliser le MST à son port actif, ainsi que pour son port inactif, afin de prendre en charge la temporisation du canal UC.

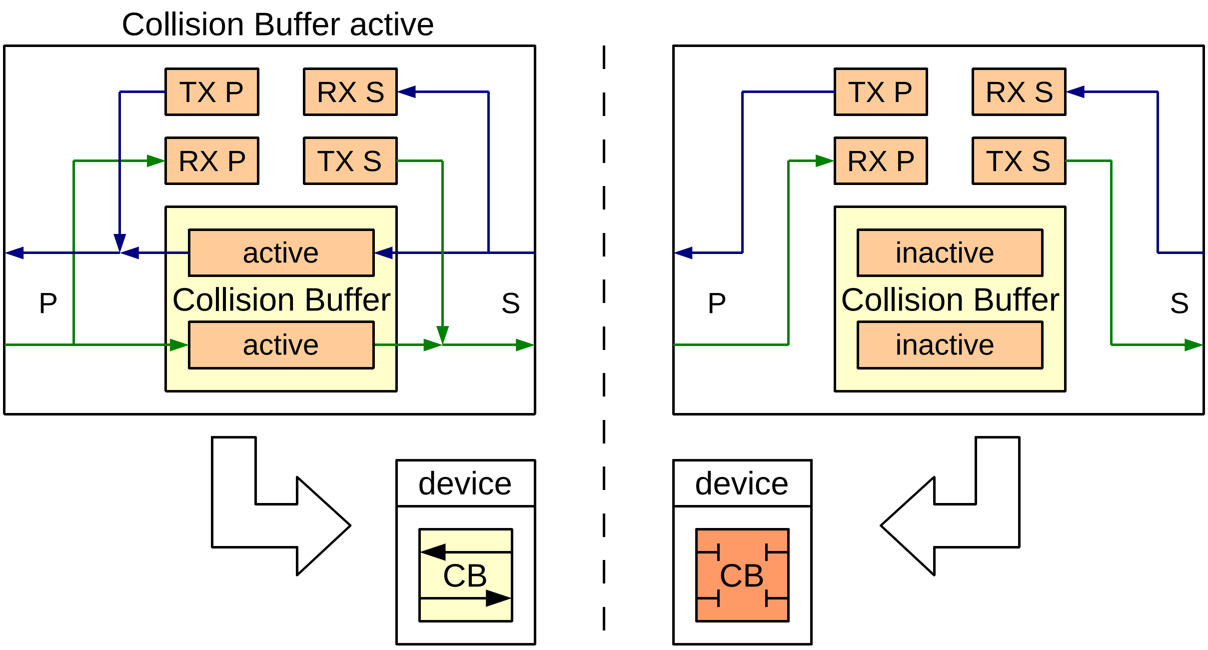
7.1.10.4 Acheminement de paquets

Chaque appareil de Type 19 qui prend en charge la communication IP peut envoyer et recevoir des paquets sur les ports principal et secondaire de son interface. Les paquets reçus sur un port de l'interface d'un appareil, qui ne sont pas destinés à l'appareil local, doivent être acheminés et envoyés sur l'autre port. Cet acheminement peut être effectué à l'aide de la méthode "archiver et acheminer" ou à l'aide de la méthode "acheminement transparent", explicitée dans la section suivante.

Dans la mesure où l'autre port peut déjà être occupé, Il faut que l'interface temporise les paquets jusqu'à ce que le port soit libre. Cette mémoire tampon est appelée Mémoire tampon de collision (CB).

La partie gauche de la Figure 62 présente un appareil avec une mémoire tampon de collision activée, ainsi que les mémoires tampons de réception et d'envoi des ports P et S.

La partie droite présente un appareil avec une mémoire tampon de collision désactivée.



Légende

Anglais	Français
Collision buffer active	Mémoire tampon de collision active
Active	Active
Collision buffer	Mémoire tampon de collision
Inactive	Inactive
Device	Appareil

Figure 62 – Mémoire tampon de collision activée et désactivée

7.1.10.4.1 Archiver et acheminer

La fonction "Archiver et acheminer" stipule que chaque paquet doit être reçu et mis en mémoire tampon dans son intégralité.

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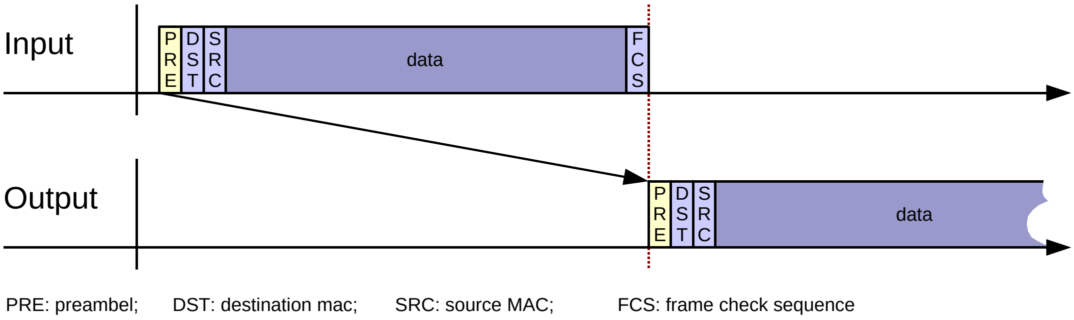
- La séquence de contrôle de trame (FCS) des paquets est vérifiée.
- Si la FCS est invalide, le paquet est rejeté.
- Dans le cas contraire, le paquet est acheminé jusqu'à la station suivante vers sa destination.

Cette méthode d'acheminement contribue à un retard du paquet à chaque station pendant une durée qui équivaut environ à son temps de transmission. La Figure 63 illustre la réponse temporelle entre un port d'entrée et un port de sortie pour un paquet acheminé.



Légende

Anglais	Français
Input	Entrée
Data	Données
Output	Sortie
Preamble	Préambule
Destination mac	Mac de destination
Source MAC	MAC source
Frame check sequence	Séquence de contrôle de trame

Figure 63 – Réponse temporelle de la méthode "archiver et acheminer"

7.1.10.4.2 Acheminement transparent

Contrairement à la méthode "archiver et acheminer", l'acheminement transparent n'attend pas la réception complète d'un paquet. Ce type d'acheminement commence en revanche à acheminer les paquets dès qu'il en connaît la destination.

- Cela signifie que, d'une part, chaque paquet est retardé uniquement pendant une durée environ équivalente au temps de transmission du préambule et de l'adresse MAC de destination (environ 1,2 µs à 100 Mbit/s).
- D'autre part, les paquets avec une FCS invalide ne sont pas rejetés.

La Figure 64 illustre la réponse temporelle entre un port d'entrée et un port de sortie pour un paquet acheminé avec l'acheminement transparent.

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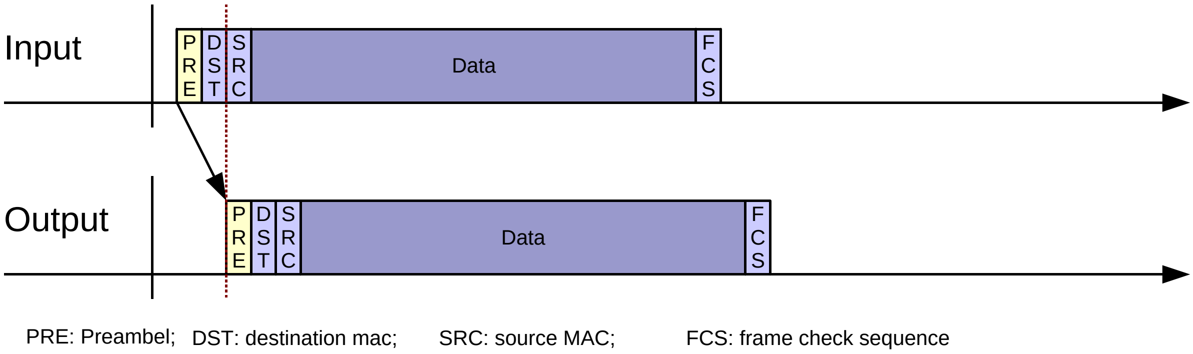

Légende

Anglais	Français
Input	Entrée
Data	Données
Output	Sortie
Preamble	Préambule
Destination mac	Mac de destination
Source MAC	MAC source
Frame check sequence	Séquence de contrôle de trame

Figure 64 – Acheminement transparent

7.1.10.5 Temporisation à la fin du canal UC

Toutes les transmissions de paquets IP doivent être achevées à la fin du canal UC (t7). Par conséquent, chaque transmission de paquets doit commencer suffisamment tôt. Cela signifie que le début de transmission tTS doit correspondre au moins à la période de transmission des paquets tTP avant t7 mais non avant t6.

Exprimé sous forme de formule, cela donne: t6 < tTS < (t7 - tTP)

7.1.10.5.1 Dernière transmission de CP0, CP1 et CP2

Avec la valeur par défaut (576) de MTU dans les phases CP0 à CP2, la dernière transmission doit commencer au moins ≥ 50 µs avant la fin du canal UC.

7.1.10.5.2 Période de transmission d'une trame Ethernet

La Figure 65 présente une trame Ethernet complète suivie de la formule de calcul de la période de transmission d'un paquet Ethernet.

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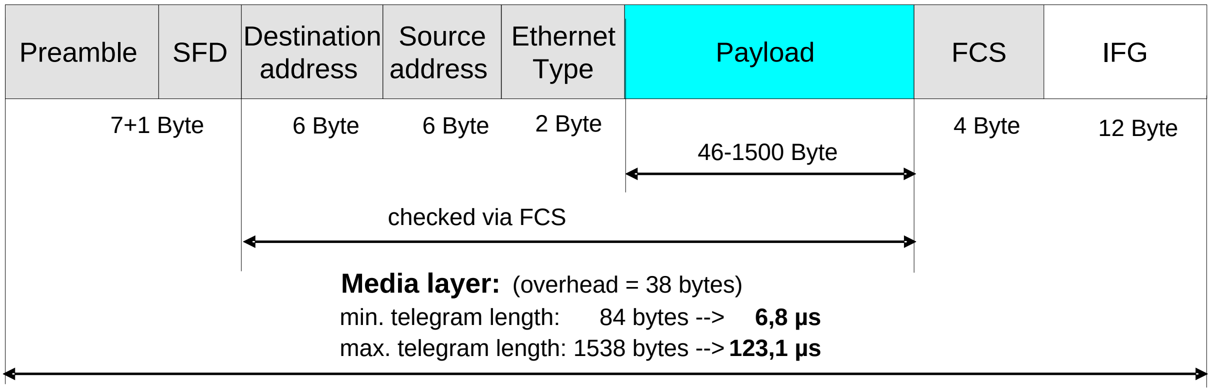

Légende

Anglais	Français
Preamble	Préambule
Destination address	Adresse de destination
Source address	Adresse source
Ethernet type	Type Ethernet
Payload	Charge utile
Byte	octet
Checked via FCS	Contrôlé via FCS
Media layer: (overhead = 38 bytes)	Couche de support: (traitement = 38 octets)
Min. telegram length: 84 bytes	Longueur minimale de télégramme: 84 octets
Max. telegram length: 1538 bytes	Longueur maximale de télégramme: 1538 octets

Figure 65 – Trame Ethernet avec charge utile

Selon la Figure 65, la période d'une trame Ethernet doit être calculée comme indiqué dans la formule suivante.

- Préambule: = 8 octets
- Adresse de destination: = 6 octets
- Adresse source: = 6 octets
- type Ethernet: = 2 octets
- FCS: (séquence de contrôle de trame) = 4 octets
- IFG: (espace entre trames) ≥ 12 octets (selon le nombre de nœuds dans la topologie, voir S-0-1036 Espace entre trames)
- Charge utile: variable qui doit contenir le nombre d'octets pour la charge utile souhaitée pour laquelle tTP doit être calculée

Calcul de la période de transmission:

- Longueur [octets] = 26 octets + charge utile + IFG
- Période de transmission (tTP) [µs] = longueur [octets] * 8 (bit) * 0,01 [µs]
- Période de transmission min. = 6,8 µs (avec 12 octets IFG)
- Période de transmission max. = 123,1 µs (avec 12 octets IFG)

7.1.10.5.3 Charge utile maximale fondée sur la longueur de canal UC

La durée du canal UC (tNRT = t7 - t6) peut être réglée sur des valeurs arbitraires jusqu'à 7µs. Une trame Ethernet peut être transmise dans le canal UC uniquement s'il s'y adapte.

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Cela signifie que le canal UC doit être plus long que la période de transmission: tNRT > tTP. Le nombre d'octets qui s'inscrivent dans une durée donnée est calculé à l'aide la formule suivante:

nombre d'octets = période de canal UC [μs] * 12,5 [octets/μs] - 38 octets

Exemple:

Si le canal UC a une durée de 250 μs, la charge utile maximale potentielle est la suivante: 250 [μs] * 12,5 [octets/μs] - 38 = 3087 octets

NOTE Ethernet spécifie que la charge utile maximale d'un paquet Ethernet est de 1500 octets.

7.1.10.6 MTU et tailles de paquets

7.1.10.6.1 Généralités

Ethernet permet une charge utile de 1500 octets au maximum par paquet. Le canal UC d'un réseau de Type 19 peut être configuré de manière à être plus court que ΔtTP(1500 octets). Cela signifie que la charge utile maximale de paquets dans le canal UC doit être limitée. Cette limite est habituellement appelée Unité de transmission maximale (MTU) qui décrit la charge utile maximale, en octets, pour un paquet simple, susceptible d'être transmise sur un réseau sans fragmentation. La limite supérieure de la MTU peut être calculée à l'aide de la formule de la section précédente:

$$MTU_{UL}(\Delta_{NRT}) = \min\{1500; a(\Delta(_{NRT})\}$$

Ethernet spécifie que la valeur minimale de l'unité de transmission maximale (MTU) est de 46 octets. Si la limite supérieure calculée de la MTU, MTU_{UL} est inférieure à 46 octets, le canal UC doit être désactivé.

La MTU affecte deux éléments d'un appareil de Type 19:

- interface d'appareil de réseau de la pile de réseau d'appareil
- matériel de communication de Type 19

7.1.10.6.2 MTU et interfaces de pile de réseau

Chaque interface réseau d'une pile de réseau comprend habituellement un attribut MTU. Cet élément est nécessaire, de sorte que des protocoles de couche supérieure tels que IPv4 peuvent déterminer la taille de paquets maximale qu'ils peuvent fournir à l'interface. Par conséquent, la MTU des interfaces de pile de réseau doit être réglée et actualisée selon S-0-1027.0.1.

7.1.10.6.3 MTU et réseaux de Type 19

Une MTU spéciale peut être demandée par un maître de communication au moyen d'une MTU demandée ou S-0-1027.0.1 d'esclave. Dans cet IDN, le maître peut définir la MTUreq demandée. La MTUcur actuelle dépend du temps de transmission NRT ou S-0-1017 et est calculée par l'esclave au changement de phase et sur l'accès en écriture à S-0-1027.0.1 MTU demandée. Un maître peut lire une MTUcur actuelle d'esclave dans la MTU effective ou S-0-1027.0.2.

7.1.10.6.4 Notes supplémentaires

- Pour une ligne ou un anneau de Type 19, il convient que chaque appareil soit configuré selon la même MTU. Dans le cas contraire, il est probable que les paquets soient perdus. Il n'y aura cependant aucun problème lorsque la ligne ou l'anneau est en état NRT.

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- La découverte de MTU de trajet (PMTUD) telle que spécifiée dans RFC1191 doit être prise en charge par tous les appareils, notamment les appareils qui acheminent les paquets entre différents réseaux.
- La valeur par défaut pour la MTU demandée est de 576 octets.

7.1.10.7 Problèmes liés à la topologie

Chaque appareil de Type 19 doit tenir compte des problèmes concernant la topologie d'un réseau de Type 19:

- Mémoires tampons de collision: Chaque appareil de Type 19 comporte une mémoire tampon de collision qui achemine les paquets d'un port à l'autre. Pour éviter un contournement permanent des diffusions dans les topologies en anneau de Type 19, une mémoire tampon de collision parmi les mémoires tampons existantes doit être désactivée.
- Table port/MAC: Chaque appareil (maîtres, esclaves et autres composants tels que les connecteurs IP) qui injecte des paquets IP dans un anneau de Type 19 envoie chaque paquet IP sur les ports principal et secondaire. Cela signifie que chaque paquet est reproduit lorsqu'il est injecté dans un anneau de Type 19. Pour éviter cette reproduction de paquets, chaque appareil doit savoir sur quel port chaque paquet unique doit être envoyé.

7.1.10.8 Table port/MAC des appareils

7.1.10.8.1 Généralités

La section 4.5.2.9 de la spécification de communication de Type 19 précise que les paquets doivent être envoyés uniquement sur un port dans le canal UC. Par conséquent, chaque appareil de Type 19 a besoin d'une table dans laquelle il archive les relations port/MAC connues. La structure de cette table, ainsi que son traitement, sont décrits dans les sections suivantes.

7.1.10.8.2 Structure

Chaque appareil de Type 19 doit maintenir une table (voir Tableau 93) dans laquelle il suit l'évolution de l'appareil qu'il atteint sur un port donné. Cette table est appelée table port/MAC et comprend au moins deux colonnes, une pour l'entrée "Port" et l'autre pour l'entrée "MAC".

Tableau 93 – Structure de la table port/MAC

Port	MAC
…	…
…	…

7.1.10.8.3 Insertion de rangées

A chaque réception par un appareil d'un paquet IP provenant d'un autre appareil, le premier appareil doit actualiser sa table Port/MAC en conséquence. Par exemple, si un appareil avec une table Port/MAC vide reçoit un paquet avec l'adresse source 0d:ea:d0:0b:ee:f0 sur le port P2, la table actualisée doit ressembler à celle illustrée au Tableau 94.

Tableau 94 – Insertion d'une entrée

Port	MAC
P2	0d:ea:d0:0b:ee:f0
…	…

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Si le même appareil reçoit une autre trame Ethernet avec la même adresse source 0d:ea:d0:0b:ee:f0, mais cette fois sur le port P1, il doit actualiser sa table Port/MAC comme présenté au Tableau 95.

Tableau 95 – Actualisation des entrées

Port	MAC
P1	0d:ea:d0:0b:ee:f0
…	…

7.1.10.8.4 Suppression de rangées

Dans certains cas, les entrées de la table Port/MAC doivent être supprimées:

- Chaque appareil doit supprimer sa table Port/MAC intégralement lorsqu'il commute de l'état NRT sur la phase CP0.
- Chaque appareil maître doit supprimer sa table Port/MAC intégralement lorsqu'un changement de la topologie physique a été détecté. Chaque appareil maître doit par conséquent ajuster le bit 11 dans la commande d'appareil de tous les esclaves en conséquence.
- Chaque appareil esclave doit supprimer sa table Port/MAC intégralement lorsque le bit 11 dans sa commande a été basculé.
- Si la table Port/MAC ne comporte plus de rangées de réserve, les rangées obsolètes doivent être supprimées. L'algorithme qui détermine l'obsolescence des rangées est laissé à la créativité des programmeurs.

7.1.10.9 Mémoire tampon de collision

7.1.10.9.1 Généralités

Afin d'éviter la formation d'un anneau, et ce lorsque les paquets de diffusion Ethernet évoluent en cercles, Il faut que précisément une mémoire tampon de collision soit inactive en présence d'une topologie en anneau physique. Etant donné que le maître d'un anneau de Type 19 doit toujours connaître la topologie existante, il doit également régler sa mémoire tampon de collision selon la topologie actuelle. Il existe deux exceptions pour lesquelles un maître détecte une topologie erronée. Dans les deux cas, un esclave doit désactiver sa mémoire tampon de collision.

7.1.10.9.2 Mémoire tampon de collision d'un esclave

A la mise sous tension et lors de la séquence de démarrage, chaque esclave doit mettre sa mémoire tampon de collision hors tension. Dès que l'esclave a achevé sa séquence de démarrage, la mémoire tampon de collision doit être réglée selon le Tableau 96:

Tableau 96 – Mémoire tampon de collision d'un esclave

Esclave avec mémoire tampon de collision	Condition
Inactif	(état NRT mode ou HP0) et (télégrammes P et S de réception) et (CP > 0)
Actif	tous les autres cas

Cela signifie que la mémoire tampon de collision de l'esclave doit être inactive uniquement si ces trois conditions sont toutes vraies:

- l'esclave est en état NRT ou HP0
- l'esclave reçoit des télégrammes P et S de Type 19

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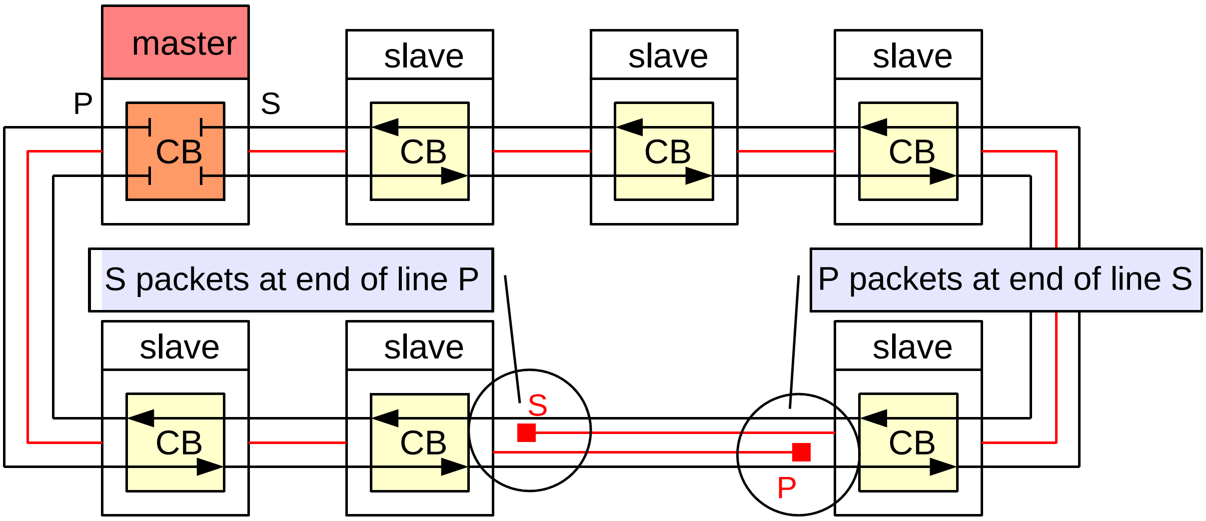
- la phase de communication des télégrammes de Type 19 reçus est supérieure à 0.

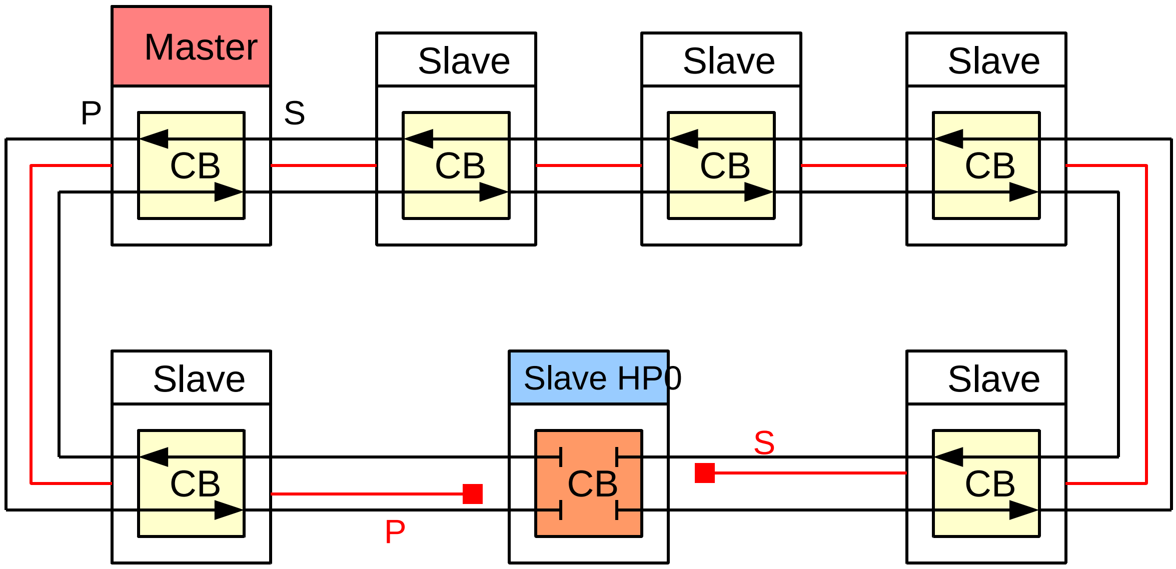
Il est nécessaire qu'un maître différencie un anneau rompu rétabli d'un anneau rompu avec des esclaves de Type 19 présents entre ces deux anneaux. Si les esclaves ne désactivent pas leur mémoire tampon de collision, un maître suppose que la topologie réelle est un anneau non consolidé. La Figure 66 et la Figure 67 ci-dessous illustrent ces deux problèmes.



Légende

Anglais	Français
Master	Maître
Slave	Esclave
S packets at end of line P	S paquets en fin de ligne P
P packets at end of line S	P paquets en fin de ligne S

Figure 66 – Anneau rompu non consolidé



Légende

Anglais	Français
Master	Maître
Slave	Esclave

Figure 67 – Anneau rompu avec insertion d'un esclave de Type 19

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7.1.10.9.3 Mémoire tampon de collision du maître

L'état de la mémoire tampon de collision du maître dépend de la phase de communication. Les sections suivantes décrivent de quelle manière la mémoire tampon de collision du maître doit être réglée pour les différentes phases.

7.1.10.9.4 Etat NRT

Chaque maître doit conserver le dernier état connu de sa mémoire tampon de collision. En l'absence d'état connu, par exemple, après la mise sous tension, il est recommandé que chaque maître commute sur CP0 afin de déterminer la topologie physique jusqu'à ce que l'AT devienne stable pendant 100 cycles.

7.1.10.9.5 Phase de communication 0

Chaque maître doit détecter la topologie physique en observant les paquets reçus sur ses ports (voir Tableau 97).

- Un anneau physique est présent si le maître reçoit des paquets S sur son port P et des paquets P sur son port S. Dans ce cas, le maître doit désactiver sa mémoire tampon de collision.
- Dans tous les autres cas, sa mémoire tampon de collision doit être activée.

Tableau 97 – Maître de topologie physique (CP0)

Commentaire	Paquets reçus par le maître sur le canal P	Paquets reçus par le maître sur le canal S	Maître avec mémoire tampon de collision
topologie en anneau	S	P	inactif
pas de topologie en anneau	*	*	actif

7.1.10.9.6 Phases de communication 1 - 4

Dans les cas suivants, la mémoire tampon de collision du maître doit être désactivée. Dans tous les autres cas, elle doit être activée. Noter que "le port UC du dernier esclave sur le canal P" fait référence aux bits d'état 10 et 11 d'appareil du dernier esclave de Type 19 sur le canal P dans la topologie linéaire. "Le port UC du dernier esclave sur le canal S" fait référence aux bits d'état 10 et 11 d'appareil du dernier esclave de Type 19 sur le canal S dans la topologie linéaire (voir Tableau 98).

Tableau 98 – Maître de topologie physique (CP 1-4)

Commentaire	Etat du port inactif du dernier esclave sur le canal P	Paquets reçus par le maître sur le canal P	Paquets reçus par le maître sur le canal S	Etat du port inactif du dernier esclave sur le canal S
anneau rompu entre le port S du maître et le dernier esclave du canal P	Télégramme S sur le port inactif	P	P	pas de dernier esclave sur le canal S
topologie en anneau	pas de dernier esclave sur le canal P	S	P	pas de dernier esclave sur le canal S
anneau rompu; HP 1/2 sur le canal P	Télégramme P sur le port inactif	P	S	Télégramme P sur le port inactif
anneau de Type 19 physiquement fermé mais non consolidé	Télégramme S sur le port inactif	P	S	Télégramme P sur le port inactif
anneau rompu entre le port P du maître et le dernier esclave du canal S	pas de dernier esclave sur le canal P	S	S	Télégramme P sur le port inactif

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Commentaire	Etat du port inactif du dernier esclave sur le canal P	Paquets reçus par le maître sur le canal P	Paquets reçus par le maître sur le canal S	Etat du port inactif du dernier esclave sur le canal S
anneau rompu; HP 1/2 sur le canal S	Télégramme S sur le port inactif	P	S	Télégramme S sur le port inactif

7.1.11 Services de protocole Internet (IPS)

7.1.11.1 Introduction

Les services de protocole Internet de Type 19 spécifient différents services pour les participants aux communications NRT dans un réseau de Type 19. Ils utilisent les protocoles suivants:

- UDP
- TCP
- TFTP

NOTE Les services de protocole Internet supposent un réseau IP ayant une configuration appropriée.

Les services sont classés par catégorie selon leur fonctionnalité comme suit:

- Services de connexion S/IP: Services de connexion requis pour l'échange de données S/IP basé sur un protocole TCP
- Services d'exploration & de configuration IP: Services pour:
  – la détection des appareils dans les réseaux de Type 19
  – la configuration IP des appareils permettant une communication point à point
- Services d'identification: Services pour l'identification des appareils S/IP
- Accès aux paramètres: Accès en lecture et écriture aux paramètres de Type 19 (IDN)
- Services de gestion des appareils:
  – Appareils de redémarrage
  – Gestion des micrologiciels TFTP
- Autres services:
  – Identification des services pris en charge
  – Surveillance des services établie sur un mécanisme à chien de garde

Ces services rendent applicables les cas d'utilisation suivants:

- Identification et configuration des appareils IP dans les réseaux de Type 19
- Essai sur pupitre d'un appareil
- Maintenance ou diagnostic des appareils sur un site industriel

7.1.11.2 Définitions générales

7.1.11.2.1 Types de données

Le Tableau 99 présente les types de données qui sont utilisés avec les PDU S/IP.

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Tableau 99 – Définition des types de données

Type	Définition	Commentaire
Bool	1 octet	Codage: 0(faux), !=0 (vrai)
octet, uint8	entier non signé à 1 octet	
int8	entier signé à 1 octet	
int16	entiers signés à 2 octets	A codage petit-boutiste
int32	entiers signés à 4 octets	A codage petit-boutiste
uint16	entiers non signés à 2 octets	A codage petit-boutiste
uint32	entiers non signés à 4 octets	A codage petit-boutiste
chaîne	à codage utf-8	Fix-Len: • Il existe un nombre fixe d'octets réservés. • Les octets non utilisés doivent être nuls. • Le dernier chiffre n'est pas égal à 0 si le codage remplit entièrement le nombre réservé d'octets! Variable-Len: • Une longueur explicite principale contient le nombre d'octets. • Le dernier chiffre n'est pas égal à 0.

Les données des IDN spécifiques de Type 19 (min, max, données d'exploitation) sont échangées sous forme de tableaux d'octets.

7.1.11.2.2 Alignement

Un alignement ne génère aucun octet de réserve.

7.1.11.2.3 Services

Les IPS sont des services différents dont l'accès est possible à l'aide de protocoles de transport différents. Les protocoles de transport ne peuvent pas tous être utilisés pour chaque service en raison des limites spécifiques des protocoles employés.

7.1.11.2.4 Identifiant de nœud

Dans la mesure où les nœuds d'un réseau de Type 19 peuvent comporter deux interfaces réseau ou plus, un nœud peut être détecté plusieurs fois. Un autre identifiant, appelé identifiant de nœud, est appliqué pour identifier un nœud de réseau de façon unique. L'identifiant de nœud est constitué de six octets. Pour les appareils esclaves, la valeur de l'identifiant de nœud doit être égale à la valeur de S-0-1019 Adresse MAC.

Pour les nœuds qui prennent en charge les IPS, mais qui n'ont pas d'interface esclave de Type 19, l'adresse MAC du premier adaptateur Ethernet doit être utilisée comme identifiant de nœud. Les nœuds sans interface Ethernet ne peuvent pas proposer les IPS.

7.1.11.3 Protocoles de transport

7.1.11.3.1 Introduction

Les services de protocole Internet (IPS) utilisent TCP, UDP et TFTP comme protocoles de transport. Selon les caractéristiques d'un service particulier, il est possible d'utiliser un ou plusieurs de ces protocoles de transport pour la transmission.

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Tous ces protocoles constituent les principaux protocoles Internet (IP). Les IPS ne prennent pas en charge la fragmentation de la couche IP.

Le Tableau 100 présente les différences entre les transmissions IPS établies sur les protocoles TCP, UDP et TFTP.

Tableau 100 – Présentation des protocoles IP

Restriction/Addition	TCP	UDP	TFTP
Echange de données	Etabli sur les connecteurs TCP	Etabli sur les datagrammes UDP	Etabli sur un datagramme UDP
Limite de la taille des données	aucune limite	Dépend de la taille des MTU	Le protocole TFTP ne prend pas en charge le transfert de fichiers dont la taille est supérieure à 32 MO. La taille minimale requise des MTU est de 576 octets.
Transmission fiable	oui	Non	oui
Contrôle de flux	oui	Non	oui
Communication à multidestination	non	Oui	non
Requiert des connexions S/IP supplémentaires	oui	Non	non

7.1.11.3.2 Gestion de protocole S/IP de type UDP

7.1.11.3.2.1 Généralités

Les demandes S/IP de type UDP sont généralement transmises au port 35021 d'un serveur UDP (0x88cd). Le client doit utiliser un connecteur relié à tout port, sauf le port 35021.

Selon le service utilisé, le protocole S/IP utilise des télégrammes UDP de diffusion ou à destination unique. En général, les télégrammes à destination unique permettent l'adressage des nœuds S/IP simples, tandis que les télégrammes de diffusion permettent l'adressage de nœuds multiples.

7.1.11.3.2.2 Limites de la taille des PDU

La taille maximale d'une transmission S/IP de type UDP se limite à la taille d'une MTU configurée.

Les restrictions suivantes au paquet de réponse peuvent être déduites en prenant en compte un paquet UDP régulier. Chaque télégramme S/IP contient une partie fixe dont la taille est de 50 octets, c'est-à-dire

- 14 octets pour l'en-tête II Ethernet
- 20 octets pour l'en-tête IP sans champs facultatifs
- 8 octets pour l'en-tête UDP
- 8 octets pour l'en-tête S/IP (ID de transaction, type de message)

La taille minimale de la PDU de réponse est donc de 50 octets. Lorsque la taille totale d'une réponse S/IP dépasse la taille d'une MTU configurée, le serveur doit répondre par l'envoi d'un télégramme d'exception (voir 7.1.11.4.3).

NOTE Afin de pouvoir utiliser un protocole TFTP sur un protocole UDP, il faut que la taille de la MTU soit au moins de 576 octets, voir également RFC-879.

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7.1.11.3.2.3 Fiabilité de transmission

En règle générale, le protocole UDP ne garantit pas l'échange de télégrammes. Les messages de demande ou de réponse peuvent être perdus lors de la communication.

Afin de surmonter ce problème, le client doit mettre en œuvre une temporisation pour chaque demande. Après la temporisation, le client peut envoyer à nouveau la même demande avec le même ID ou un nouvel ID de transaction.

Le serveur traite chaque demande entrante et renvoie la réponse au client. Le serveur ne doit pas mettre en œuvre de fonction permettant de s'assurer que les demandes reproduites ne seront exécutées qu'une seule fois.

7.1.11.3.2.4 Services à destination unique

Les services S/IP recourant à des télégrammes à destination unique UDP peuvent être appliqués si le serveur et le client font partie d'un même sous-réseau ou de sous-réseaux différents. La réponse du serveur est également un télégramme à destination unique UDP.

7.1.11.3.2.5 Services de diffusion

Un protocole S/IP utilise les télégrammes de diffusion UDP pour

- atteindre de nombreux appareils avec une seule demande
- permettre l'établissement d'une communication avec des appareils à configuration non adaptés. Par exemple: un appareil peut être relié au même réseau physique, mais sa configuration IP est inconnue ou non valide. L'adresse IP peut être celle d'un sous-réseau non valide ou différent.

Le serveur peut répondre aux télégrammes de diffusion UDP par des télégrammes à destination unique ou de diffusion UDP. Lorsque le sous-réseau IP du client est différent de celui du serveur, ce dernier doit envoyer la réponse sous forme de télégramme de diffusion. Dans le cas contraire, la réponse doit être envoyée sous forme de télégramme à destination unique afin d'éviter toute charge CPU sur les autres appareils.

7.1.11.3.3 Gestion de protocole S/IP de type TCP

7.1.11.3.3.1 Généralités

Les demandes S/IP sont généralement transmises au port 35021 d'un serveur TCP (0x88cd). Le client peut utiliser tout port affecté par sa pile TCP.

Lorsque le protocole S/IP de type TCP est utilisé, il est nécessaire qu’une connexion S/IP soit établie avant que d'autres services S/IP puissent être sollicités.

7.1.11.3.3.2 Connexions S/IP

La connexion S/IP prévoit les fonctions suivantes:

- La connexion S/IP est établie par le client.
- La connexion S/IP fait l'objet d'un contrôle de temporisation par le client et le serveur (voir Temporisations).
- Les propriétés d'une connexion S/IP y compris les temporisations, les informations de version et les types de télégrammes pris en charge, font l'objet d'une négociation lors du démarrage de la connexion.
- Le serveur peut proposer plusieurs connexions. Le client peut se connecter à un serveur à plusieurs reprises au moyen de plusieurs connecteurs TCP.

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- Lors de l'arrêt de la connexion, il convient de libérer toutes les ressources utilisées en interne dans le client et le serveur.

Il faut que la connexion S/IP soit établie après le lancement de la connexion par connecteurs TCP.

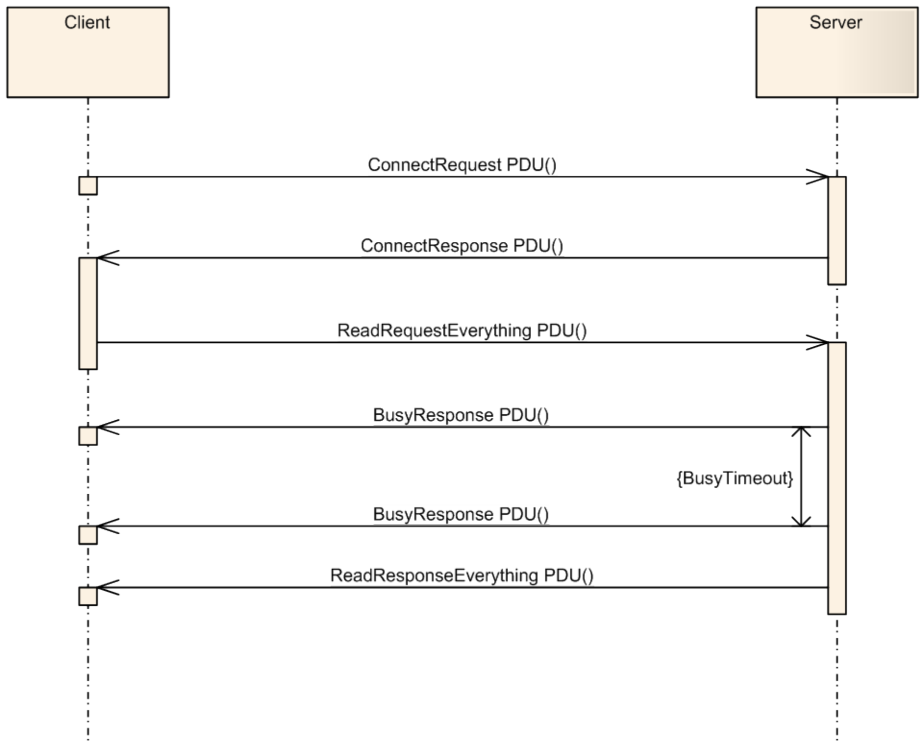
Les services requis pour le lancement de la connexion sont décrits dans les Services de connexion S/IP.

Lorsque le serveur n'est pas capable de traiter une connexion S/IP de type TCP, il doit envoyer un télégramme d'exception au client (voir 7.1.11.4.3).

Les deux temporisations suivantes permettent de contrôler les connexions S/IP.

- Temporisation d'exploitation: Elle précise la période de temps qui suit l'arrêt par le serveur d'une connexion au repos avec le client. Cette temporisation est destinée à sauvegarder les ressources sur le serveur en cas de perte de la liaison avec le client sans un arrêt approprié de la connexion TCP. Il convient que le client fasse appel au Service Ping S/IP pour éviter la temporisation d'exploitation. Chaque nouvelle demande du client doit redémarrer la temporisation d'exploitation au niveau du serveur.
- Temporisation d'occupation: Elle précise la période de temps au cours de laquelle il convient que le serveur réponde à la demande du client. Si le serveur traite la demande et n'est pas capable de répondre dans la période de temporisation d'occupation, il doit envoyer des réponses "occupé" au client dans le cadre du cycle de temporisation d'occupation. Si le client ne reçoit ni la réponse "occupé", ni la réponse à la demande en attente dans la période de temporisation d'occupation, il doit interrompre la connexion avec le serveur.

Chaque réponse du serveur doit contribuer au redémarrage de la temporisation d'exploitation au niveau du client. La Figure 68 présente un exemple de messages avec réponse "occupé".



Légende

Anglais	Français
Client	Client

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Anglais	Français
Server	Serveur
Busy timeout	Temporisation "occupé"

Figure 68 – Réponse "occupé" S/IP

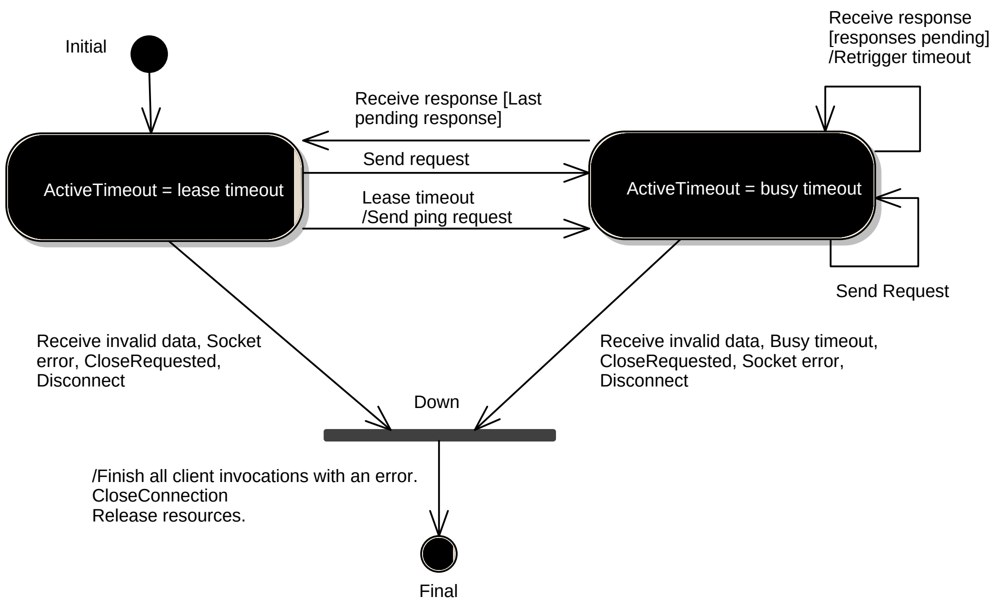
La réponse "occupé" contribue au redémarrage de la temporisation d'occupation d'une demande ouverte. La réponse "occupé" se présente comme suit:

```
struct BusyResponse // MessageType: 68

{

}
```

La Figure 69 illustre un diagramme d'états d'une connexion S/IP du point de vue du client, y compris tous les états et transitions pour les temporisations d'occupation et d'exploitation, que le client S/IP doit mettre en œuvre.



Légende

Anglais	Français
Initial	Initial
Receive response	Réception réponse
Responses pending	Réponses en attente
Retrigger timeout	Redéclenchement temporisation
Last pending response	Dernière réponse en attente
Lease timeout	Temporisation d'occupation
Send ping request	Envoi demande ping
Busy timeout	Temporisation d'occupation
Send request	Envoi demande
Receive invalid data	Réception données invalides
Socket error	Erreur de connexion
Disconnect	Déconnecter

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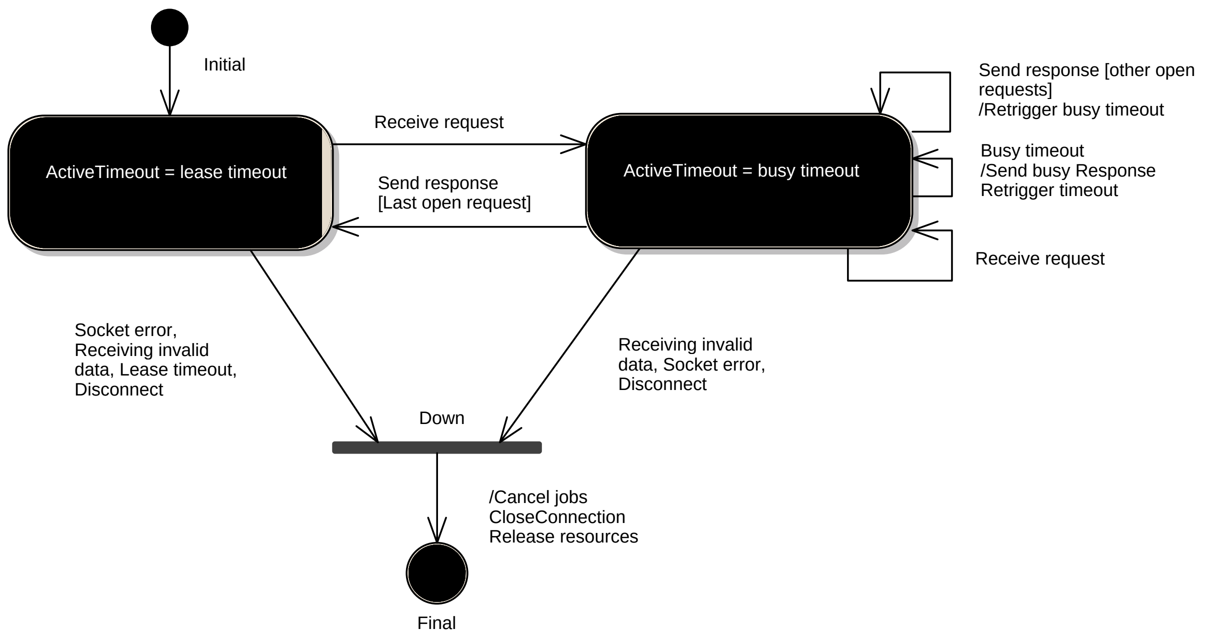
Anglais	Français
Down	Descendant
Finish all client invocations with an error	Terminer toutes les invocations client avec une erreur
Release resources	Libération ressources
Final	Fin

Figure 69 – Connexion client

La Figure 70 illustre un diagramme d'états d'une connexion S/IP du point de vue du serveur, y compris tous les états et transitions pour les temporisations d'occupation et d'exploitation, que le serveur S/IP doit mettre en œuvre.



Anglais	Français
Initial	Initial
Receive request	Réception demande
Send response	Envoi réponse
Other open requests	Autres réponses ouvertes
Retrigger busy timeout	Redéclenchement temporisation d'occupation
Last open request	Dernière demande ouverte
Busy timeout	Temporisation occupée
Lease timeout	Temporisation d'occupation
Send busy response	Envoi réponse "occupé"
Retrigger timeout	Redéclenchement temporisation
Socket error	Erreur de connexion
Receiving invalid data	Réception de données invalides
Disconnect	déconnecter
Down	Descendant
Cancel jobs	Annuler tâches
Release resources	Libération ressources
Final	Fin

Figure 70 – Connexion serveur

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7.1.11.3.4 TFTP

Le protocole TFTP tel que spécifié dans la norme RFC 1350 doit être le protocole standard réservé au transfert de fichiers.

L'appareil de Type 19 doit mettre en œuvre un serveur TFTP.

- Le nom de fichier active une action associée sur l'appareil de Type 19.
- Le contenu doit être vérifié par l'appareil de Type 19. Si l'état de fonctionnement de l'appareil de Type 19 est incorrect, cet appareil doit renvoyer le message d'erreur TFCTP correspondant. Par exemple, violation d'accès, y compris un message d'erreur significatif.
- Le message d'erreur de chaîne du protocole TFTP doit servir à transmettre des messages d'erreur significatifs lisibles.
- Le protocole TFTP doit permettre de télécharger des micrologiciels.

Il est admis de déclencher des fonctions ou des commandes de l'appareil via le protocole TFTP en utilisant des noms de fichiers spéciaux. Les fonctions, noms de fichiers et contenus de fichiers sont spécifiques au fournisseur et non définis par le qualificatif "Type 19".

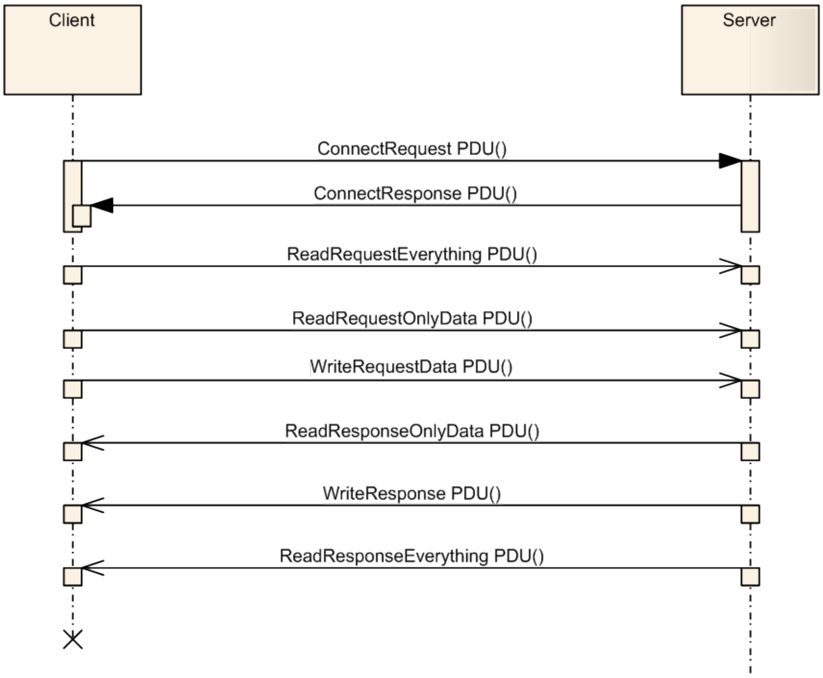
NOTE Le protocole TFTP ne prend pas en charge le transfert de fichiers dont la taille est supérieure à 32 MO.

7.1.11.4 Communication

7.1.11.4.1 Généralités

Chaque service S/IP est défini par une demande et un message de réponse. Le client peut envoyer plusieurs demandes avant de recevoir une réponse du serveur. Par ailleurs, le serveur peut traiter les demandes entrantes dans l'ordre qui lui convient.

La Figure 71 présente un exemple de réponses par le serveur, dans un ordre différent, à trois demandes.



Légende

Anglais	Français
Client	Client

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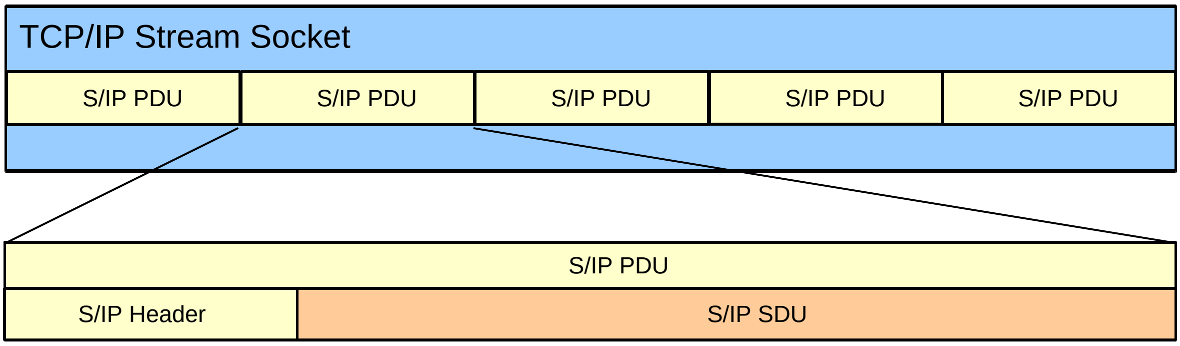
Anglais	Français
Server	Serveur

Figure 71 – Réponse asynchrone S/IP

Si le serveur reçoit une demande avec un type de message inconnu, la demande doit être ignorée et un télégramme d'exception doit être renvoyé au client. La réponse aux télégrammes de diffusion avec un type de message inconnu ne doit pas être un télégramme d'exception d'erreur (voir 7.1.11.4.3).

Chaque demande et chaque réponse se composent d'un en-tête S/IP suivi d'une unité de données de service S/IP (SDU), comme illustré à la Figure 72.



Anglais	Français
TCP/IP stream socket	Connecteur de flux TCP/IP
S/IP header	En-tête S/IP

Figure 72 – PDU S/IP

7.1.11.4.2 En-tête S/IP

7.1.11.4.2.1 Généralités

L'en-tête S/IP contient un identifiant de transaction et le type de mesage de la PDU. La structure se présente comme suit:

```
struct header {

 uint32 TransactionID;

uint32 MessageType;

}
```

7.1.11.4.2.2 ID de transaction

L'en-tête S/IP contient un identifiant de transaction afin de distinguer les différentes paires de demande-réponse du client. Cet identifiant de transaction est un numéro d'identification défini par le client demandeur pour chaque demande. Le serveur utilise le même identifiant de transaction (comme pour une demande) pour la réponse correspondante. Le client utilise l'identifiant de transaction d'une réponse pour attribuer la réponse à une demande en attente correspondante.

7.1.11.4.2.3 Types de message

Le type de message identifie le service sollicité des appareils de Type 19.

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Le Tableau 101 présente les services qui ont été normalisés par le protocole S/IP.

Tableau 101 – Types de message

Services S/IP	Demande de type de message	Réponse de type de message	TCP	UDP
SupportedUDPServices	61	62	-	X
Connect	63	64	X	-
Ping	65	66	X	X
ReadEverything	69	70	X	X
ReadOnlyData	71	72	X	X
ReadDescription	73	74	X	X
WriteName	75	76	X	X
WriteAttribute	77	78	X	X
WriteUnit	79	80	X	X
WriteMinMax	81	82	X	X
WriteData	83	84	X	X
WriteDataBits	85	86	X	X
ReadDataStatus	87	88	X	X
Nameplate	89	90	X	X
NameplateBroadcast	99	-	-	X
Browse	91	100	-	X
Identify	93	94	-	X
SetIp	95	96	-	X
Watchdog	101	102	X	X
Interfaces	103	104	X	X
Slaves	105	106	X	X
BrowseOnSlaveInterfaces	107	108	X	X
ReadSegment	109	110	X	X
Exception	-	67	X	X
Busy	-	68	X	X
Reset	97	-	-	X
Réservé	92	-	-	-

Les types de message spécifiques au fabricant règlent le bit de poids fort du type de message sur 1 (voir Tableau 102). Les 15 bits suivants contiennent le type de message réel spécifique au fabricant (0..32767). Les 16 bits de poids faible contiennent le code fournisseur géré par SI (S-0-1300.x.03 Code fournisseur).

Tableau 102 – Types de message spécifiques à l'utilisateur

Type de message (spécifique à l'utilisateur)	1uuuuuuuuuuuuuuuvvvvvvvvvvvvvvvv (binaire)
u: Type de message spécifique à l'utilisateur	(0..32767)
v: Type 19	Code fournisseur (VendorCode)

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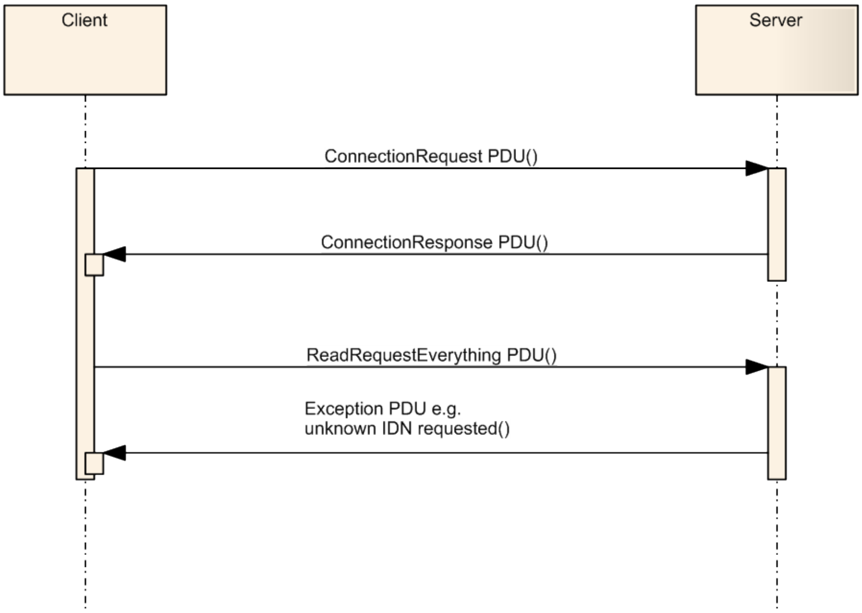
7.1.11.4.3 Traitement des exceptions

7.1.11.4.3.1 Généralités

Lorsqu'un service est sollicité, que le serveur ne peut pas gérer avec succès, le serveur renvoie un télégramme d'exception au client. L'identifiant de transaction du télégramme d'exception est identique à celui de la demande.

Un serveur ne doit pas répondre par un télégramme d'exception à une demande de diffusion UDP, qui ne contient pas son identifiant de nœud.

La Figure 73 présente un télégramme d'exception réservé à une demande d'un IDN non existant.



Légende

Anglais	Français
Client	Client
Server	Serveur
Exception PDU e.g. unknown IDN requested	Exception PDU, par exemple, IDN demandé

Figure 73 – Réponse d'erreur S/IP

7.1.11.4.3.2 Structure d'un télégramme d'exception

Le télégramme d'exception contient un code d'erreur commun et un code d'erreur facultatif spécifique au service.

```
struct Exception  // MessageType: 67

{

 uint16 CommonErrorCode; // see enum below

 uint32 SpecificErrorCode; // service specific error codes,

    // e.g. error codes of service channel

}
```

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7.1.11.4.3.3 Codes d’erreur communs

```
enum CommonErrorCode

{

 CONNECTION_ERROR = 1, // connection can not be established

 TIMEOUT = 2,  // connection lost, timeout

 UNKNOWN_MESSAGE_TYPE = 3, // service not supported

 SERVICE_SPECIFIC = 4, // service specific error

    // --> see SpecificErrorCode for details

 PDU_TOO_LARGE = 5, // request or response does not fit

    // to the UDP datagram

    // (limitation of PDU size)

 PDU_PROTOCOL_MISMATCH = 6 // malformed PDU e.g. received UDP datagram does not

    // correspond to the expected PDU size

}
```

NOTE Pour les définitions des codes d'erreur spécifiques au service, se reporter aux services S/IP correspondants.

Le Tableau 103 dresse la liste des codes d'erreur communs associés à leur contexte d'utilisation.

Tableau 103 – Codes d’erreur communs

Code d’erreur	Contexte
CONNECTION_ERROR	Lorsque le serveur n'est pas capable de gérer une connexion S/IP de type TCP. Voir Initialisation des communications de type TCP pour plus de détails.
TIMEOUT	En cas de dépassement d'une temporisation (voir Temporisations pour plus de détails) ou de perte de connexion TCP. Les activités du réseau sont contrôlées par la gestion des temporisations locales. Lorsque le serveur ne répond pas dans les délais impartis, ce code d'erreur permet de signaler l'erreur à l'utilisateur côté client.
UNKNOWN_MESSAGE_TYPE	Lorsque le serveur reçoit un type de message inconnu, il doit envoyer un télégramme d'exception au client, accompagné de ce code d'erreur. En cas de demande S/IP de type TCP, le serveur renvoie le télégramme d'exception au client et doit fermer la connexion de flux TCP.
SERVICE_SPECIFIC	Les services sont en mesure d'avoir leur propre code d'erreur. Des informations supplémentaires sont disponibles dans le SpecificErrorCode de la structure des télégrammes d'exception. Voir également les descriptions de code d'erreur spécifiques du service appelé.
PDU_TOO_LARGE	Il s'agit d'une erreur spécifique au protocole UDP. Voir Limites de la taille d'une PDU pour plus de détails.
PDU_PROTOCOL_MISMATCH	Il s'agit d'une erreur spécifique au protocole UDP. Par exemple, la longueur du datagramme reçu n'est pas conforme à la taille de PDU prévue du service. Cette erreur indique une mise en œuvre incompatible.

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7.1.11.5 Services

7.1.11.5.1 Généralités

Les sections suivantes décrivent les services fournis par le protocole S/IP.

Les informations, permettant de déterminer les services pris en charge par un appareil donné, peuvent être obtenues par l'un des mécanismes suivants:

- comme partie intégrante de la réponse de connexion lorsque des connexions S/IP de type TCP sont utilisées (voir 7.1.11.5.2).
- le service SupportedUDPServices peut être utilisé pour obtenir une liste de tous les services UDP pris en charge par un appareil (voir 7.1.11.5.7.1).

7.1.11.5.2 Service de connexion S/IP

7.1.11.5.2.1 Généralités

Ce service permet d'établir et de maintenir une connexion S/IP à l'aide du protocole S/IP de type TCP.

7.1.11.5.2.2 Service Connexion

Ce service peut être utilisé via le protocole de transport suivant: TCP.

7.1.11.5.2.2.1 Demande de connexion

Pour lancer une connexion S/IP, le client envoie au serveur une PDU ConnectRequest. Cette demande contient le numéro de version S/IP souhaité, ainsi que les valeurs de temporisation souhaitées pour la connexion.

```
struct Connect  // MessageType: 63

{

 uint32 version;  // S/IP protocol version

    // version=1 shall used for this

    // protocol version

 uint32 busyTimeout;  // requested busy-timeout in milliseconds,

    // the server should use

 uint32 leaseTimeout;  // requested lease-timeout in milliseconds,

    // the server should use

}
```

7.1.11.5.2.2.2 Réponse de connexion

Lorsque le serveur est capable de gérer la connexion, une ConnectResponsePDU doit être renvoyée au client. Dans la ConnectionResponsePDU, le serveur fournit au client sa version de protocole, ainsi que les valeurs de temporisation d'occupation et d'exploitation actives pour la connexion. Lorsque le serveur ne peut pas gérer la version souhaitée du client, sa réponse doit comporter un numéro de version disponible inférieur ou égal au numéro de version souhaité.

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De plus, la ConnectResponsePDU contient une liste des services pris en charge par le serveur.

```
struct ConnectResponse  // MessageType: 64
{
 uint32 version;  // S/IP protocol version
    // version=1 is used for this
    // protocol version
 uint32 busyTimeout;  // busy-timeout in milliseconds,
    // the server is using
 uint32 leaseTimeout;  // lease-timeout in milliseconds,
    // the server is using
    // typically 10000 - 30000 msec
 uint32 noMessageTypes; // number of Request MessageTypes
 uint32 messagetypes[]; // The supported Request MessageTypes
    // of the server on this TCP connection.
    // The client must only use these
// message types in a request.
}
```

Lorsque le serveur n'est pas capable de gérer la connexion, une PDU d'exception doit être renvoyée (voir Erreur de connexion).

Lorsque les valeurs de temporisation dans la ConnectResponsePDU divergent des valeurs de la ConnectRequestPDU, le client est tenu d'ajuster les valeurs de temporisation afin de prendre en compte les retards et les temps de réaction de l'application.

7.1.11.5.2.3 Service Ping

Ce service peut être utilisé via les protocoles de transport suivants: TCP, UDP (à destination unique).

Lorsque le serveur ne reçoit aucun télégramme du client avant la temporisation d'exploitation, il peut fermer la connexion au client. Ce dernier peut redéclencher la temporisation d'exploitation grâce au service Ping.

7.1.11.5.2.3.1 Demande Ping

```
struct Ping  // MessageType: 65
{
}
```

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7.1.11.5.2.3.2 Réponse Ping

```
struct PingResponse // MessageType: 66 (pong)

{

}
```

7.1.11.5.3 Services d'exploration et de configuration IP

7.1.11.5.3.1 Généralités

Les services suivants permettent d'explorer les appareils internes aux réseaux de Type 19 et de configurer leurs paramètres IP.

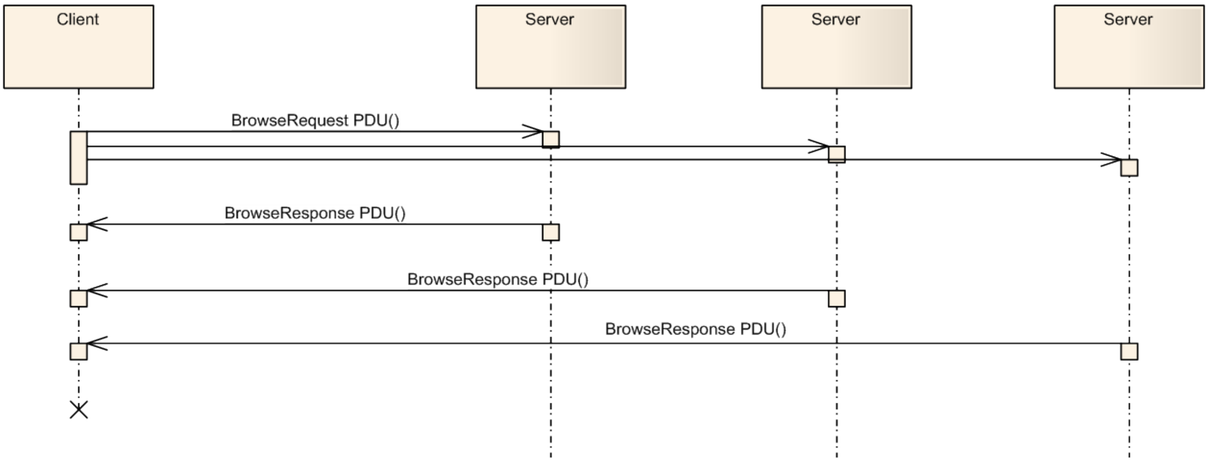
7.1.11.5.3.2 Service Browse (Explorer)

Ce service peut être utilisé via le protocole de transport suivant: UDP (diffusion).

Le service Browse (Explorer) permet de détecter les appareils internes au même sous-réseau.

La Figure 74 présente la séquence suivante des services Browse (Explorer).

- Un outil logiciel (client) envoie une demande Browse (Explorer) comme télégramme de diffusion UDP général au réseau local. Cette demande permet de régler les filtres de sorte qu'il ne soit pas nécessaire que tous les appareils de Type 19 locaux (serveurs) envoient une réponse. Les filtres potentiels sont:
  – Maître uniquement: Seuls les appareils qui sont des appareils maîtres de communication sur le réseau local doivent répondre.
  – Espace adressable: Seuls les appareils adaptés à l'espace d’adresse d’appareil souhaité doivent répondre.
- Tous les appareils de Type 19 (serveurs) qui reçoivent la demande Browse (Explorer) et satisfont à la condition de filtrage doivent envoyer une réponse Browse (Explorer). Cette réponse contient des informations telles que la configuration réseau actuelle de l'appareil, les types FSP et le nom qui permet d'identifier facilement cet appareil.



Légende

Anglais	Français
Client	Client
Server	Serveur

Figure 74 – Exploration UDP

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7.1.11.5.3.2.1 Demande Browse (Explorer)

```
struct Browse   // MessageType = 91

{

    // ipaddress of the sending node.

    // The ip-address must correspond

    // to the interface of the sender

 byte ipaddress[4];  // [0] msb, [3] lsb

 bool masterOnly;  // if != 0, only devices who have

    // a Type 19 master interface

    // shall reply



 uint16 lowerType19Address; // Only devices with a Type 19 address

    // between lower and upper bound shall

    // reply. If both values are 0, all

    // devices shall reply. This filter

    // setting is not relevant for

    // master devices.

 uint16 upperType19Address;

}
```

7.1.11.5.3.2.2 Réponse Browse (Explorer)

La BrowseResponse dépend de l'interface de réception de la BrowseRequest. Les éléments spécifiques à l'interface sont l'adresse MAC, les fonctions DHCP, le mode DHCP, l'adresse IP, le sous-réseau et la passerelle.

Si le service de mise en œuvre ne connaît pas l'interface de réception, il convient qu'il envoie une réponse pour chaque interface, et pour toutes les interfaces.

Exemple: Soit un appareil comportant 2 interfaces, à savoir l'interface 1 et l'interface 2. Dans ce cas, il convient que le service

- envoie la réponse contenant les informations dédiées à l'interface 1 pour les interfaces 1 et 2, et
- envoie la réponse contenant les informations dédiées à l'interface 2 pour les interfaces 1 et 2.

Il convient que le client (celui qui a envoyé la demande Browse) vérifie l'identifiant de nœud afin de détecter les réponses multiples provenant d'un nœud.

```
struct BrowseResponse  // MessageType: 100
```

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```
{
 uint32 version;  // S/IP protocol version
     // version=1 is used for this
// protocol version
 byte node_identifier[6]; // node identifier
// 00:11:22:33:44:55 [0] = 00, [5] = 55
 byte macAddress[6];  // mac address of the interface from which
     // the response has been sent.
// 00:11:22:33:44:55 [0] = 00, [5] = 55
 byte DHCPFeatures;  // bit[0]: dhcp client available
     // bit[1]: dhcp server available
// bit[2]: dhcp relay agent available
 byte DHCPMode;   // 0: no dhcp a static IP address is used
// 1: dhcp client active
     // 2: dhcp server active
// 3: dhcp relay agent active
 byte ipaddress[4];  // [0] msb, [3] lsb
 byte subnet[4];  // [0] msb, [3] lsb
 byte gateway[4];  // ip address of responsible gateway
 uint32 dplength;  // length of display name in octets
 byte displayname[dplength]; // display name to identify the device
     // in an browser
     // length should not exceed 64 characters
 uint32 hnlength;  // length of hostname in octets
 byte hostname[hnlength]; // name to identify the node S-0-1039
}
```

Lorsqu'un serveur reçoit une demande avec une taille de PDU non valide, il doit ignorer le télégramme et ne doit pas envoyer de télégramme d'exception d'erreur.

L'élément "displayname" (nom d'affichage) peut contenir des informations qui permettent une identification unique de l'appareil déterminé. Il est censé faire l'objet d'un affichage direct comme information unique d'une interface utilisateur. Il convient que la taille du displayname ne dépasse pas 64 caractères. Il convient que son langage soit neutre.

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Exemples:

- <device type><serial number> --> "LXM62PS (12345678-0000)"
- <application type><device identification number><sudevice address> --> "AT:X-Achse ID:8a AD:12"

7.1.11.5.3.3 Service SetIp

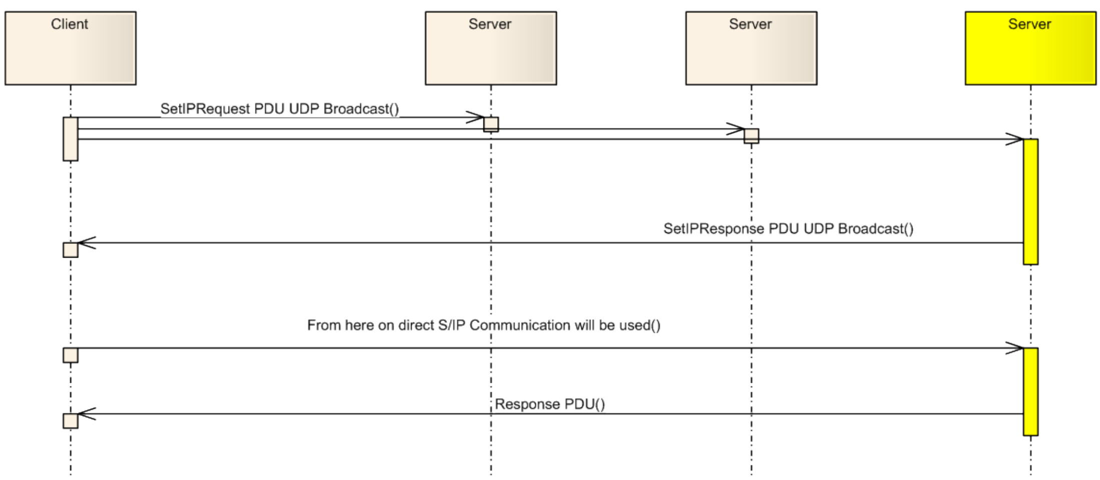
Ce service peut être utilisé via le protocole de transport suivant: UDP (diffusion).

Le service SetIp permet de définir une configuration IP d'une interface.

Les paramètres "ipaddress" (adresse IP), "subnet" (sous-réseau) et "gateway" (passerelle) sont ignorés lorsque le client DHCP est activé.

La Figure 75 présente la séquence relative au service de configuration de réseau.

- Un client envoie une demande de configuration IP comme télégramme de diffusion UDP général au réseau local. L'identifiant de nœud permet d'adresser l'appareil à configurer. La demande contient une configuration IP complète pour l'appareil. Si l'adresse de passerelle transmise n'est pas adaptée à la configuration de réseau transmise, aucune passerelle par défaut ne doit être définie (0.0.0.0). La nouvelle configuration peut être définie de façon permanente ou provisoire (jusqu'au redémarrage). Ceci est indiqué par le champ permanent dans la structure de la demande.
- L'appareil de Type 19 adressé doit soit
  - répondre par un message de réponse IP défini et activer la nouvelle configuration de réseau. L'ordre d'exécution des deux actions n'est pas défini. Cela signifie que la réponse IP définie peut être envoyée avec l'ancienne ou la nouvelle configuration IP.
  - ou répondre par un message d'erreur sous forme de télégramme de diffusion UDP. Ceci peut être effectué si:
    - L'appareil est en mode de fonctionnement contrôlé par un maître de Type 19 ou
    - L'appareil ne prend pas en charge la définition d'une configuration de réseau provisoire.



Légende

Anglais	Français
Client	Client
Server	Serveur
From here on direct S/IP communication will be	A partir d'ici communication S/IP directe utilisée

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Anglais	Français
used	
Response PDU	PDU de réponse

Figure 75 – Séquence de définition d'une nouvelle configuration de réseau sur un appareil avec UDP

NOTE 1 Régler l'élément "passerelle" de la demande sur "0.0.0.0" afin de désactiver la fonctionnalité de la passerelle.

NOTE 2 Si le service est utilisé pour l'interface esclave, il convient que les paramètres reflètent les réglages: ipaddress (adresse IP) (voir S-0-1020 adresse IP), sous-réseau (voir S-0-1021 Masque de sous-réseau), passerelle (voir S-0-1022 Adresse de passerelle).

7.1.11.5.3.3.1 Demande SetIp

```
struct SetIp               // MessageType = 95
{                          // node identifier of the device
  byte node_identifier[6]; // 00:11:22:33:44:55 [0] = 00, [5] = 55
  byte macAddress[6];      // mac address of the interface.
                           // 00:11:22:33:44:55 [0] = 00, [5] = 55
  byte DHCPMode;           // 0: DHCP disabled
                           // 1: enable dhcp client
                           // 2: enable dhcp server
                           // 3: enable dhcp relay agent
  byte ipaddress[4];       // [0] msb, [3] lsb
                           // new subnet mask
  byte subnet[4];          // [0] msb, [3] lsb
                           // default gateway to forward ip messages
  byte gateway[4];         // [0] msb, [3] lsb
  bool persistent;         // if != 0, store settings persistent
  uint32 hnlength;         // length of hostname in octets
  byte hostname[hnlength]; // name to identify the node (see S-0-1039)
}
```

7.1.11.5.3.3.2 Réponse SetIp

```
struct SetIpResponse       // MessageType = 96
{
}
```

In case of an error an Exception SDU containing an error code will be sent.

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```
enum SetIpErrorCode
{
  INVALID_DEVICE_STATE = 1       //  invalid device state
                                 // (IP  configuration cannot be activated)
  TEMP_IP_NOT_SUPPORTED  = 2     // temporary IP configuration is
                                 // not supported
  INVALID_SERVICE_DATA  = 3      // The given data are incorrect
  SET_IP_NOT_SUPPORTED  = 4      // setting of static IP_ address
                                 // is not supported
  INVALID_DHCP_MODE  = 5         // device does not support DHCP_MODE
}
```

7.1.11.5.3.4 Service Interfaces

Ce service peut être utilisé via les protocoles de transport suivants: TCP, UDP (à destination unique).

Ce service obtient toutes les interfaces d'un nœud.

7.1.11.5.3.4.1 Demande Interfaces

```
struct Interfaces  // MessageType = 103
{
}
```

7.1.11.5.3.4.2 Réponse Interfaces

```
struct InterfacesResponse        // MessageType = 104
{
  byte node_identifier[6];       // 00:11:22:33:44:55 [0] = 00, [5] = 55
  uint32 dplength;               // length of display name in octets
  byte displayname[dplength];    // display name to identify the device
                                 // in an browser, see BrowseRespone
                                 // length should not exceed 64 characters
  uint32 noInterfaces;           // number of interfaces
  struct
  {
```

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```
    byte macAddress[6];    // mac address of the interface 00:11:22:33:44:55 [0] = 00,
[5] = 55

    byte ipAddress[4];    // [0] msb, [3] lsb ipaddress of the slave interface

    byte interfaceType;   // 0: an Ethernet interface, e. g. engineering port

                          // 1: a Type 19 Slave interface

                          // 2: a Type 19 Master interface

  } interfaces[noInterfaces];

}
```

7.1.11.5.3.5 Service Esclaves

Ce service peut être utilisé via les protocoles de transport suivants: TCP, UDP (à destination unique).

Ce service obtient tous les esclaves connectés à une interface maître. Seuls les maîtres de Type 19 sont tenus de mettre en œuvre ce service.

7.1.11.5.3.5.1 Demande Esclaves

```
struct Slaves                        // MessageType = 105

{

  byte macAddress[6];                // mac address of the master interface

                                     // 00:11:22:33:44:55 [0] = 00, [5] = 55

}
```

7.1.11.5.3.5.2 Réponse Esclaves

```
struct SlavesResponse          // MessageType = 106

{

  uint32 noSlaves;             // number of slaves

  struct

  {

    byte ipaddress[4];         // [0] msb, [3] lsb ipaddress of the slave

    byte node_identifier[6];  // 00:11:22:33:44:55 [0] = 00, [5] = 55

  } slaves[noSlaves];

}
```

En cas d'erreur, une SDU Exception contenant un code d'erreur est transmise.

```
enum SlavesErrorCode
```

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```
{
  INVALID_MAC_ADDRESS = 1      // Interface MAC address is not valid
                               // for Slaves service
}
```

7.1.11.5.3.6 Interface BrowseOnSlaveInterface

Ce service peut être utilisé via les protocoles de transport suivants: TCP, UDP (à destination unique).

Ce service demande au maître de rechercher les maîtres dans une autre interface esclave. Seuls les maîtres de Type 19 sont tenus de mettre en œuvre ce service. Ce service permet à un esclave de ring1 d'obtenir les informations fournies par son maître (ring1) concernant un autre anneau (ring2). Le nœud, maître de ring1, doit être un esclave de ring2. Les réponses Browse sont recueillies par le serveur pendant une durée timeToBrowse. Au terme de cette durée, le serveur communique les réponses recueillies au client.

7.1.11.5.3.6.1 Demande BrowseOnSlaveInterface

```
struct BrowseOnSlaveInterface       // MessageType = 107
{
  byte macAddress[6];               // macAddress of the slave interface
                                    // to browse for masters
  int32 timeToBrowse;               // time to wait for responses in
                                    // milliseconds
}
```

7.1.11.5.3.6.2 Réponse BrowseOnSlaveInterface

```
struct BrowseOnSlaveInterfaceResponse // MessageType = 108
{
  uint32 noMasters;                   // number of masters
  struct
  {
    byte node_identifier[6];   // master node identifier
                               // 00:11:22:33:44:55 [0] = 00, [5] = 55
    byte ipaddress[4];         // master ip address
                               // [0] msb, [3] lsb ipaddress
                               // of the slave
  } masters[noMasters];
```

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```
}
```

En cas d'erreur, une SDU Exception contenant un code d'erreur est transmise.

```
enum BrowseOnSlaveInterfaceErrorCode

{

  INVALID_MAC_ADDRESS = 1      // Interface MAC address is not valid

                               // for Slaves service

}
```

7.1.11.5.4 Services d'identification

7.1.11.5.4.1 Généralités

Les services suivants permettent l'identification des appareils S/IP.

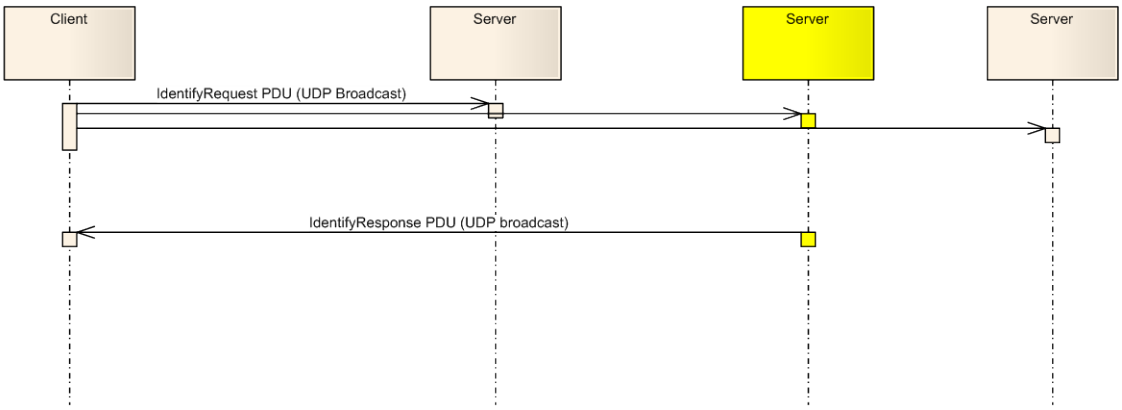
7.1.11.5.4.2 Service Identify (Identifier)

Ce service peut être utilisé via le protocole de transport suivant: UDP (diffusion).

Le service Identify permet d'identifier un appareil en lui demandant de s'auto-identifier, par exemple par un clignotement.

La Figure 76 présente la séquence relative au service d'identification UDP.

- Un client envoie une demande d'identification comme télégramme de diffusion UDP général au réseau local. L'identifiant de nœud de la demande d'identification permet d'adresser l'appareil à identifier.
- L'appareil de Type 19 adressé doit s'auto-identifier, l'appareil émettant un signal pendant 4 secondes. Le signal s'arrête ensuite automatiquement. Le comportement des DEL émettant un signal est défini dans la section Type 19_LED. L'appareil identifié doit également envoyer une réponse d'identification.



Légende

Anglais	Français
Client	Client
Server	Serveur

Figure 76 – Identification UDP

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7.1.11.5.4.2.1 Demande Identify (identification)

```
struct Identify            // MessageType = 93

{

                           // node identifier of the device

  byte node_identifier[6]; // 00:11:22:33:44:55 [0] = 00, [5] = 55

}
```

7.1.11.5.4.2.2 Réponse Identify (identification)

Seul l'appareil adressé envoie une réponse.

```
struct IdentifyResponse // MessageType = 94

{

}
```

7.1.11.5.4.3 Service Nameplate (Plaque signalétique)

Ce service peut être utilisé via les protocoles de transport suivants: TCP, UDP (à destination unique).

Le service Nameplate sollicite la plaque signalétique électronique du nœud. Les informations concernant la plaque signalétique sont renvoyées sous forme de liste des entrées de plaque signalétique. Chaque entrée comporte un identifiant principal et une valeur de chaîne. Les identifiants sont définis dans le Tableau 104. En l'absence de définition explicite, le format d'affichage de la valeur de chaîne est donné par l'attribut de l'IDN auquel il est fait référence.

7.1.11.5.4.3.1 Demande Nameplate (plaque signalétique)

```
struct Nameplate                   // MessageType = 89

{

}
```

7.1.11.5.4.3.2 Réponse Nameplate (plaque signalétique)

```
struct NameplateResponse           // MessageType = 90

{

  uint32 noEntries;                // number of nameplate entries

  struct

  {

     byte id;                      // id of the nameplate entry

     uint32 length;                // length of value in octets

     byte[length] value;           // value of the nameplate entry:

                                   // string Variable-Len
```

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```
  } nameplate_entries[noEntries];

}
```

Tableau 104 – Identifiants de Nameplate (plaque signalétique)

ID	Nom	Commentaires
1	(réservé)	
2	Nom du fournisseur	fait référence à S-0-1300.x.02 Nom du fournisseur
3	Code fournisseur de Type 19	fait référence à S-0-1300.x.03 Code fournisseur
4	Nom de l'appareil	fait référence à S-0-1300.x.04 Nom de l'appareil
5	ID de l'appareil du fournisseur	fait référence à S-0-1300.x.05 ID de l'appareil du fournisseur
6	(réservé)	
7	Révision des fonctions	fait référence à S-0-1300.x.07 Révision des fonctions
8	Révision HW	fait référence à S-0-1300.x.08 Révision du matériel
9	Révision FW	fait référence à S-0-1300.x.09 Révision du logiciel
10	Révision du chargeur de micrologiciel	fait référence à S-0-1300.x.10 Révision du chargeur de micrologiciel
11	(réservé)	
12	Numéro de série	fait référence à S-0-1300.x.12 Numéro de série
13	Date de construction	fait référence à S-0-1300.x.13 Date de construction
14 … 19	(réservé)	
20	Heures de fonctionnement	fait référence à S-0-1300.x.20 Heures de fonctionnement
21 … 31	(réservé)	
32	Hostname (Nom d'hôte)	fait référence à S-0-1039 Nom d'hôte
33	Nombre d'esclaves	fait référence au nombre d'éléments de liste de S-0-1046 Liste des adresses de sous-appareil dans l'appareil le format d'affichage doit être un décimal non signé
34 … 127	(réservé)	
128 …255	Spécifique au constructeur	

7.1.11.5.4.4 Service NameplateBroadcast

Ce service peut être utilisé via le protocole de transport suivant: UDP (diffusion).

Le service NameplateBroadcast permet de recueillir les informations concernant un appareil.

La NameplateResponse renvoie une liste de paramètres IDN. Cette liste peut être utilisée pour des informations supplémentaires concernant les appareils ne comportant pas de paramètres de communication définis.

```
struct NameplateBroadcast  // MessageType = 99

{                          // node identifier of the device

  byte node_identifier[6]; // 00:11:22:33:44:55 [0] = 00, [5] = 55

}
```

La réponse est définie dans le service Nameplate.

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7.1.11.5.5 Accès aux paramètres

7.1.11.5.5.1 Généralités

Dans la plupart des cas, un appareil de Type 19 ne comporte qu'une seule interface et de ce fait une seule adresse IP. Pour pouvoir accéder aux paramètres (paramètres de lecture et d'écriture) à partir de différents esclaves d'un appareil, les esclaves doivent faire l'objet d'un adressage dans la demande. Cet adressage s'effectue au moyen d'un index d'esclave. Cet index constitue une numérotation interne de tous les esclaves dans un appareil.

Le nombre d'esclaves dans un appareil correspond au nombre d'éléments du paramètre général S-0-1046. L'absence du paramètre S-0-1046 indique que l'appareil comporte exactement un esclave. Dans ce cas, la valeur zéro doit être utilisée pour l'index d'esclave. Des paramètres généraux existent avec tout index d'esclave.

Un appareil peut définir des paramètres supplémentaires grâce à la structure de paramètres de Type 19. Ces paramètres sont accessibles par SlaveExtension. Il convient que SlaveExension soit nulle lorsqu'elle n'est pas utilisée.

7.1.11.5.5.2 Données de paramètre

Le codage des données de paramètre, y compris les valeurs minimale et maximale, correspond au codage de la voie de service, avec certaines exceptions décrites ci-dessous:

- Le codage est un codage petit-boutiste.
- La longueur de la valeur est donnée avec la taille de l'attribut de (1,2,4,8) en octets.
- Le paramètre comprenant une chaîne sous forme de données utilise des listes d'éléments à 1 octet. La longueur des données de paramètre représente la longueur de codage de la chaîne en octets, et non le nombre de caractères. Le dernier octet n'est pas égal à 0. Les chaînes sont codées au format utf-8.
- Listes:
  – L'en-tête de liste qui contient la longueur maximale et la longueur actuelle ne fait pas partie intégrante des données S/IP. Seules les données de valeurs d'éléments de liste font partie intégrante des informations transmises.
  – La longueur actuelle de la liste est renvoyée par l'élément datalength (longueur de données). Le nombre d'éléments dans la liste peut être évalué au moyen des informations concernant la taille des éléments de l'attribut et la longueur des données.
  – Utiliser ReadEverything ou ReadDescription pour obtenir la taille de liste disponible maximale en octets.

7.1.11.5.5.3 IDN

Les IDN sont associés aux services pour l'adressage d'un paramètre spécifique. Ils font également partie intégrante de la valeur de paramètre, si le format d'affichage des paramètres est "IDN". Voir la spécification IDN pour les méthodes de codage et de décodage de l'IDN.

7.1.11.5.5.4 Codes d'erreur spécifiques au service de paramètre

L'énumération suivante définit les codes d'erreur spécifiques au service pour le protocole S/IP. Voir également les codes d'erreur SVC

```
enum SipErrorCode

{

  // 0x0 - 0x7FFFFFFF                    // reserved for SVC Error Codes,
```

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```
                                        //  e.g. 0x1001 No IDN
  // > 0x80000000                       // Addition Error Codes
  SLAVE_INDEX_INVALID      = 0x80000001,
  PARAMETER_INVALID        = 0x80000002, // can be used to avoid invalid access;
                                        // e.g. write access to procedure commands
  PARAMETER_NOT_ACCESSIBLE = 0x80000003, // Parameter cannot be accessed
                                        // e.g. if parameter database is not ready
}
```

7.1.11.5.5.5 Service ReadEverything

Ce service peut être utilisé via les protocoles de transport suivants: TCP, UDP (à destination unique).

7.1.11.5.5.5.1 Demande ReadEverything

```
struct ReadEverything          // MessageType: 69
{
 uint16 SlaveIndex;
 uint16 SlaveExtension;
 uint32 IDN;
}
```

7.1.11.5.5.5.2 Réponse ReadEverything

```
struct ReadEverythingResponse  // MessageType: 70
{
  uint16   validelements;  // bitmask of the following elements,
                           // which are valid in this response
                           // invalid length elements shall be set to 0
                           // bitmask | description
                           // -------------------------------------------------
  uint16   data_status;    // 0x01    | data valid & command
                           //         | acknowledge ref. IDN numbers
  uint16   namelength;     // 0x02    | length of datablock element 2 in octets
  uint32   attribute;      // 0x04    | datablock element 3
  uint16   unitlength;     // 0x08    | length of datablock element 4 in octets
```

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```
  byte[8]  min;            // 0x10    | datablock element 5
  byte[8]  max;            // 0x20    | datablock element 6
  uint32   maxlistlength;  // --      | maximum length of datablock element 7
                           //         | in octets. Valid if parameter is a list
  uint32   datalength;     // 0x40    | length of datablock element 7 in octets
  byte[namelength] name;   // 0x02    | name of parameter; string Variable-Len
  byte[unitlength] unit;   // 0x08    | unit of parameter; string Variable-Len
  byte[datalength] data;   // 0x40    | datablock element 7
}
```

La réponse doit contenir tous les éléments mis en œuvre de l'IDN.

7.1.11.5.5.6 Service ReadyOnlyData

Ce service peut être utilisé via les protocoles de transport suivants: TCP, UDP (à destination unique).

7.1.11.5.5.6.1 Demande ReadyOnlyData

```
struct ReadOnlyData            // MessageType: 71
{
 uint16 SlaveIndex;
 uint16 SlaveExtension;
 uint32 IDN;
}
```

7.1.11.5.5.6.2 Réponse ReadyOnlyData

```
struct ReadOnlyDataResponse    // MessageType: 72
{
  uint32 attribute;
  uint32 length;               // length of data counted in octets
  byte[length] data;
}
```

7.1.11.5.5.7 Service ReadDescription

Ce service peut être utilisé via les protocoles de transport suivants: TCP, UDP (à destination unique).

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7.1.11.5.5.7.1 Demande ReadDescription

```
struct ReadDescription         // MessageType: 73

{

 uint16 SlaveIndex;

 uint16 SlaveExtension;

 uint32 IDN;

}
```

7.1.11.5.5.7.2 Réponse ReadDescription

```
struct ReadDescriptionResponse // MessageType: 74

{

  uint16   validelements;  // bitmask of the following elements,

                           // which are valid in this response

                           // invalid length elements shall be set to 0

                            // bitmask | description

                           // -------------------------------------------------

  uint16   namelength;     // 0x02    | length of datablock element 2 in octets

  uint32   attribute;      // 0x04    | datablock element 3

  uint16   unitlength;     // 0x08    | length of datablock element 4 in octets

  byte[8]  min;            // 0x10    | datablock element 5

  byte[8]  max;            // 0x20    | datablock element 6

  uint32   maxlistlength;  // --      | maximum length of datablock element 7

                           //         | in octets. Valid if parameter is a list

  byte[namelength] name;   // 0x02    | name of parameter; string Variable-Len

  byte[unitlength] unit;   // 0x08    | unit of parameter; string Variable-Len

}
```

NOTE Il faut que la réponse contienne tous les éléments mis en œuvre de l'IDN.

7.1.11.5.5.8 Service ReadDataStatus

Ce service peut être utilisé via les protocoles de transport suivants: TCP, UDP (à destination unique).

7.1.11.5.5.8.1 Demande ReadDataStatus

```
struct ReadDataStatus         // MessageType: 87
```

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```
{
  uint16 SlaveIndex;
  uint16 SlaveExtension;
  uint32 IDN;
}
```

7.1.11.5.5.8.2 Réponse ReadDataStatus

```
struct ReadDataStatusResponse // MessageType: 88
{
  uint16   data_status;        // data valid & command acknowledge
                               // refer to the IDN numbers
}
```

7.1.11.5.5.9 Service ReadSegment

Ce service peut être utilisé via les protocoles de transport suivants: TCP, UDP (à destination unique).

Ce service lit les éléments de données d'exploitation. La longueur de la réponse dépend du type de données.

7.1.11.5.5.9.1 Demande ReadSegment

```
struct ReadSegment                  // MessageType: 109
{
  uint16 SlaveIndex;
  uint16 SlaveExtension;
  uint32 IDN;
  uint16 StartIndex;                // 0 based index of the first
                                    // list element
  uint16 NumberOfRequestedElements; // requested number of list elements
}
```

7.1.11.5.5.9.2 Réponse ReadSegment

```
struct ReadSegmentResponse          // MessageType: 110
{
  uint32 attribute;
  uint16 NumberOfAvailableElements; // Number of listelements
```

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```
  uint32 length;                    // length of data counted
                                    // in octets
  byte[length] data;                // parameter data
}
```

L'appareil peut renvoyer moins d'éléments que demandé. Une réponse comportant moins d'éléments indique que la taille d'une MTU peut être trop petite ou que la fin de la liste est atteinte.

Si l'index de données de la demande est hors norme, le serveur doit répondre avec une longueur de données nulle.

Les IDN de longueur fixe doivent être traités comme des IDN de liste de longueur 1.

7.1.11.5.5.10 Service WriteName

Ce service peut être utilisé via les protocoles de transport suivants: TCP, UDP (à destination unique).

7.1.11.5.5.10.1 Demande WriteName

```
struct WriteName              // MessageTypes: 75
{
  uint16           SlaveIndex;
  uint16           SlaveExtension;
  uint32           IDN;
  uint16           namelength;
  byte[namelength] name;      // string Variable-len */;
}
```

7.1.11.5.5.10.2 Réponse WriteName

```
struct WriteNameResponse      // MessageTypes: 76
{
                              // empty response; data was written correctly
                              // in case of an error, an exception will be
                              // sent instead
}
```

7.1.11.5.5.11 Service WriteAttribute

Ce service peut être utilisé via les protocoles de transport suivants: TCP, UDP (à destination unique).

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7.1.11.5.5.11.1 Demande WriteAttribute

```
struct WriteAttribute          // MessageType: 77

{

  uint16  SlaveIndex;

  uint16  SlaveExtension;

  uint32  IDN;

  uint32  attribute;

}
```

7.1.11.5.5.11.2 Réponse WriteAttribute

```
struct WriteAttributeResponse  // MessageTypes: 78

{

                               // empty response; data was written correctly

                               // in case of an error, an exception will be

                               // sent instead

}
```

7.1.11.5.5.12 Service WriteUnit

Ce service peut être utilisé via les protocoles de transport suivants: TCP, UDP (à destination unique).

7.1.11.5.5.12.1 Demande WriteUnit

```
struct WriteUnit               // MessageType: 79

{

  uint16           SlaveIndex;

  uint16           SlaveExtension;

  uint32           IDN;

  uint16           unitlength;

  byte[unitlength] unit;       // string with var-len

}
```

7.1.11.5.5.12.2 Réponse WriteUnit

```
struct WriteUnitResponse     // MessageType: 80

{

                             // empty response; data was written correctly
```

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```
                             // in case of an error, an exception will be
                             // sent instead
}
```

7.1.11.5.5.13 Service WriteMinMax

Ce service peut être utilisé via les protocoles de transport suivants: TCP, UDP (à destination unique).

7.1.11.5.5.13.1 Demande WriteMinMax

```
struct WriteMinMax           // MessageType: 81
{
  uint16  SlaveIndex;
  uint16  SlaveExtension;
  uint32  IDN;
  byte[8] min;               // datablock element 5
  byte[8] max;               // datablock element 6
}
```

7.1.11.5.5.13.2 Réponse WriteMinMax

```
struct WriteMinMaxResponse   // MessageType: 82
{
                             // empty response; data was written correctly
                             // in case of an error, an exception will be
                             // sent instead
}
```

7.1.11.5.5.14 Service WriteData

Ce service peut être utilisé via les protocoles de transport suivants: TCP, UDP (à destination unique).

7.1.11.5.5.14.1 Demande WriteData

```
struct WriteData             // MessageType: 83
{
  uint16  SlaveIndex;
  uint16  SlaveExtension;
  uint32  IDN;
```

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```
  uint32  length;           // length of data counted in octets
  byte[length] data;
}
```

7.1.11.5.5.14.2 Réponse WriteData

```
struct WriteDataResponse    // MessageType: 84
{
                            // empty response; data was written correctly
                            // in case of an error, an exception will be
                            // sent instead
}
```

7.1.11.5.5.15 Service WriteDataBits

Ce service peut être utilisé via les protocoles de transport suivants: TCP, UDP (à destination unique).

7.1.11.5.5.15.1 Demande WriteDataBits

```
struct WriteDataBits        // MessageType: 85
{
  uint16  SlaveIndex;
  uint16  SlaveExtension;
  uint32  IDN;
  uint32  length;           // length of data and mask counted in octets
  byte[length] data;        // value of bits to be modified
  byte[length] dataMask;    // bits to be modified
}
```

Lorsque la longueur transmise par le client est inférieure à la taille du paramètre, le serveur doit étendre le bit de poids fort (MSB) du masque et la valeur avec 0 octet.

NOTE WriteDataBits est pris en charge uniquement pour les paramètres autres que les paramètres de liste.

7.1.11.5.5.15.2 Réponse WriteDataBits

```
struct WriteDataBitsResponse // MessageType: 86
{
                            // empty response; data was written
                            // correctly in case of an error, an
```

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```
                    // exception will be sent instead
}
```

7.1.11.5.6 Services de gestion des appareils

7.1.11.5.6.1 Service Reset (Réinitialiser)

Ce service peut être utilisé via le protocole de transport suivant: UDP (diffusion).

Le service Reset (Réinitialiser) permet de réinitialiser un ou plusieurs appareils dans un réseau.

Dans la mesure où ce service va interrompre la communication, il est nécessaire que la réinitialisation soit retardée par le serveur. Les appareils qui doivent participer à la réinitialisation sont identifiés par des node_identifiers. Dès qu'un appareil a reçu une demande de réinitialisation, ce dernier doit déclencher un temporisateur interne, la réinitialisation ayant effectivement lieu après écoulement de la durée de temporisation. En raison des pertes de données potentielles, il est recommandé au client de réitérer la demande cinq fois au maximum avec un intervalle de ~100 ms entre les demandes. Lorsqu'un serveur reçoit à deux reprises une demande de réinitialisation, le temporisateur doit être redémarré. Lorsqu'une situation ne permet pas l'exécution de la demande de réinitialisation, par exemple, des conditions de sécurité, ladite demande doit être ignorée par l'appareil.

Le nombre maximal d'appareils pouvant être adressés par une demande de réinitialisation est limité à 85. Cette limite est due à la restriction portant sur la taille des paquets UDP. Lorsqu'il convient de redémarrer plus de 85 appareils, l'envoi consécutif de différentes demandes de réinitialisation est possible.

Ce service doit effectuer une réinitialisation à froid. Ce service a pour objectif principal l'activation des fichiers de mise à jour dépendants, transférés par exemple via un protocole TFTP.

NOTE Les appareils ne répondront pas à cette demande.

7.1.11.5.6.1.1 Demande Reset (Réinitialiser)

```
struct Reset                                    // MessageType = 97
{
  uint32 timeout;                               // waiting time in milliseconds
                                                //  until reset is performed by the
device
  uint16 no_node_identifiers;                     // number of node_identifiers inside
range
                                                // from 0 to 85. If 0, no device shall
                                                // perform a reset,
                                                // else the amount of node_identifiers
  byte node_identifier[no_node_identifiers][6]; // Array of node_identifiers:
                                                // 00:11:22:33:44:55 [0] = 00, [5] = 55
}
```

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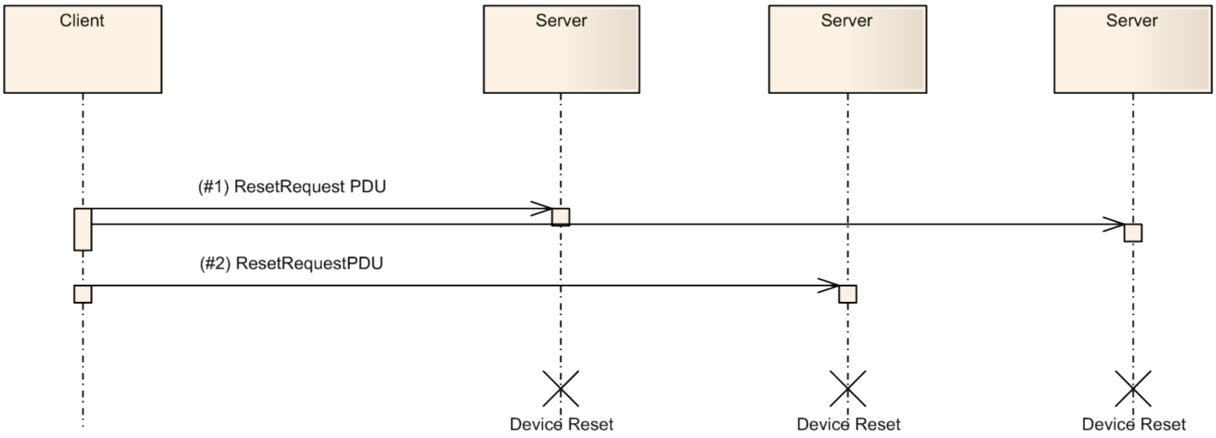
La Figure 77 présente l'application de ResetRequest UDP. Un outil client est utilisé pour envoyer deux demandes de réinitialisation. La première demande vise à réinitialiser les premier et troisième appareils. Une fois la demande envoyée, l'utilisateur souhaite réinitialiser également le deuxième appareil. Par conséquent, l'outil client envoie une deuxième demande qui adresse uniquement le deuxième appareil. Après écoulement de la temporisation, les appareils réinitialisent le matériel.



Légende

Anglais	Français
Client	Client
Server	Serveur
Device reset	Réinitialisation appareil

Figure 77 – Application de la demande de réinitialisation UDP

NOTE La Figure 77 n'illustre pas la répétition recommandée des demandes envoyées.

7.1.11.5.6.2 Gestion / Actualisation des micrologiciels TFTP

Ce service peut être utilisé via le protocole de transport suivant: TFTP

- La gestion des micrologiciels utilise le protocole TFTP.
- Une réponse doit être apportée à toute erreur en utilisant les messages d'erreur TFTP, par exemple, mauvaise version de micrologiciel y compris un message d'erreur descriptif. Les messages d'erreur TFTP ne doivent pas être utilisés pour un fonctionnement satisfaisant.

Une activation globale d'un nouveau micrologiciel doit être sollicitée par le service de réinitialisation.

7.1.11.5.7 Autres services

7.1.11.5.7.1 Services SupportedUDPServices

Ce service peut être utilisé via le protocole de transport suivant: UDP (à destination unique).

Ce service renvoie une liste de tous les services "S/IP de type UDP" (à destination unique et diffusion) pris en charge.

7.1.11.5.7.1.1 Demande SupportedUDPServices

```
struct SupportedUDPServices         // MessageType: 61

{
```

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```
}
```

7.1.11.5.7.1.2 Réponse SupportedUDPServices

```
struct SupportedUDPServicesResponse // MessageType: 62

{

  uint32 noMessageTypes;            // number of Request MessageTypes

  uint32 messagetypes[];            // The supported request

                                    // MessageTypes of the server

                                    // The client shall only use

                                    // these message types in a request.

}
```

7.1.11.5.7.2 Services Watchdog (Chien de garde)

Ce service peut être utilisé via les protocoles de transport suivants: TCP, UDP (à destination unique).

Ce service met en œuvre un mécanisme d'entretien applicable à une activité. Ce mécanisme peut être utilisé pour s'assurer de l'aboutissement dans les délais des activités spécifiques de l'appareil, initiées par le client.

Alors que l'appareil exécute l'activité spécifique, le client doit continuer à déclencher le chien de garde pour que l'activité se poursuive. Ce mécanisme permet à l'appareil de savoir que le client est toujours actif et qu'il observe l'activité effectivement exécutée. Lorsque l'appareil ne reçoit pas de demande du chien de garde avant la temporisation, en raison de problèmes de communication, l'appareil interrompt automatiquement l'activité spécifique. Se reporter à la Figure 78 pour des informations détaillées.

Exemple: Il convient d'utiliser ce service pour achever un mouvement d'axe initié par le client S/IP.

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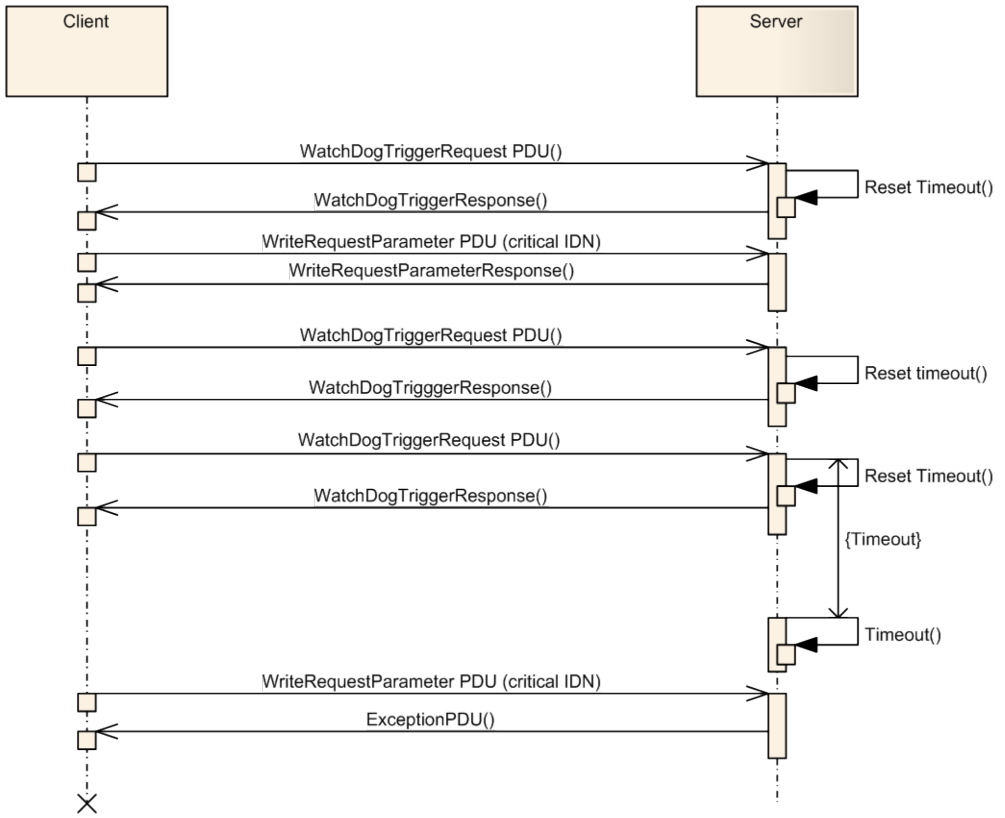

Légende

Anglais	Français
Client	Client
Server	Serveur
Reset timeout	Réinitialisation temporisation
Timeout	Temporisation

Figure 78 – Séquence relative au service de déclenchement du chien de garde et à la temporisation de l'application client

Ce message de service doit toujours être transmis en cas de mouvement d'un axe via un accès aux paramètres avec un protocole S/IP. Lorsque ce message de service n'est pas transmis par le serveur pendant une durée spécifique, un chien de garde doit déclencher et placer l'appareil dans un état de sécurité.

Etant donné que le protocole S/IP sert uniquement au transport des données, il ne peut pas assurer la sûreté fonctionnelle lors du mouvement des axes. La définition d'un état de sécurité et les valeurs de temporisation dépendent de l'appareil et ne peuvent pas être spécifiées par le protocole S/IP.

A titre d'exemple, les IDN critiques tels que S-0-0134 concernant les entraînements, doivent être accessibles en écriture, tant que le chien de garde est actif. Après expiration du chien de garde, ce qui correspond à son état initial, tous les IDN critiques doivent être réinitialisés sur des valeurs de secours. Chaque appareil doit connaître ses propres IDN critiques. Si le chien de garde n'est plus actif et s'il convient de saisir un IDN critique, le message d'erreur SVC 0x700c, "Les données d'exploitation sont protégées en écriture, en raison d'autres paramètres (par exemple, paramètre, mode de fonctionnement, entraînement activé, entraînement sous tension, etc.)" doit être transmis comme réponse.

Le message de demande reçu par un appareil réinitialise le chien de garde des appareils. L'appareil répond à la demande par un message de réponse, y compris la période d'expiration

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du chien de garde en millisecondes. Fait référence au service de déclenchement du chien de garde.

7.1.11.5.7.2.1 Demande Watchdog (chien de garde)

```
struct WatchdogTrigger         // MessageType: 101

{

}
```

7.1.11.5.7.2.2 Réponse Watchdog (chien de garde)

```
struct WatchdogTriggerResponse // MessageType: 102

{

  uint32 timeout;              // in milliseconds

}
```

7.1.11.6 Classification

Le Type 19 définit plusieurs classes IPS pouvant être mises en œuvre par les appareils.

Si un appareil prend en charge une classe, tous les services de cette classe doivent être mis en œuvre. Le Tableau 105, le Tableau 106, le Tableau 107, le Tableau 108, le Tableau 109 et le Tableau 110 présentent les services obligatoires pour le maître et les esclaves. Le Tableau 105 présente les classes de protocole Internet définies.

Tableau 105 – Classes IPS

ID de classe	Nom de la classe	Commentaires
1	TCP de base	
2	UDP de base	
3	Gestion des appareils	
4	Services d'exploration & de configuration IP	
5	Accès aux paramètres de Type 19	

Au moins une classe parmi les classes TCP de base ou UDP de base (voir Tableau 106 et Tableau 107) doit être mise en œuvre.

Tableau 106 – Classe TCP de base

Service	Si UDP pris en charge	Si TCP pris en charge
Connect	-	X
Ping	-	X
Busy (Occupé)	-	X
Nameplate	-	X

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Tableau 107 – Classe UDP de base

Service	Si UDP pris en charge	Si TCP pris en charge
Nameplate	X	-
SupportedUdpServices	X	-

Tableau 108 – Classe Gestion des appareils

Service	Si UDP pris en charge	Si TCP pris en charge
Actualisation des micrologiciels TFTP	X	X

Tableau 109 – Services d'exploration & de configuration IP

Service	Si UDP pris en charge	Si TCP pris en charge
Browse	X	-
SetIpConfiguration	X	-
Identify	X	-

Tableau 110 – Classe Accès aux paramètres de Type 19

Service	Si UDP pris en charge	Si TCP pris en charge
ReadEverything	X	X
ReadOnlyData	X	X
ReadDescription	X	X
ReadDataStatus		X
ReadSegment	X	
WriteData	X	X
WriteDataBits	X	X

7.2 Synchronisation

7.2.1 Synchronisation de réseau

7.2.1.1 Généralités

La synchronisation doit être utilisée pour les esclaves de synchronisation qui prennent en charge SCP_Sync uniquement et comporte plusieurs fonctions.

- Compensation des temps de retard physique (tring).
- Détermination du temps de référence de synchronisation (TSref) par rapport au retard de l'anneau.
- Signal déclencheur de synchronisation avec fin de MST (TTref).
- Détermination du temps de synchronisation optimal (TSync) par rapport aux temps de traitement des esclaves.

Le maître doit mesurer les temps de retard physique (tring) en phase CP0, CP1 ou CP2, comme cela est spécifié dans le présent article. Il doit également transmettre le retard de l'anneau (S-0-1015) à tous les esclaves de synchronisation. Le maître peut mesurer également les temps de retard physique en phase CP4 à des fins de contrôle et de diagnostic.

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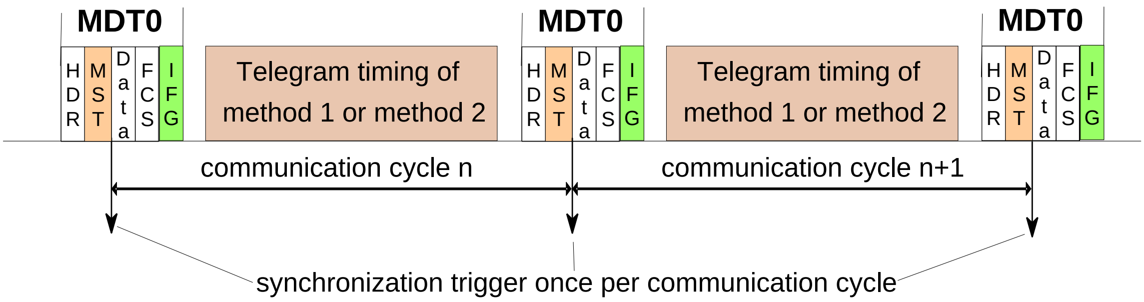
Les esclaves doivent alors calculer son délai de synchronisation interne (S-0-1016 Retard de l'esclave (P&S)). Ce temps de synchronisation et tous les temps déduits de ce dernier dans l'esclave doivent être activés à l'aide de la commande de procédure de mesure de retard SYNC (S-0-1024).

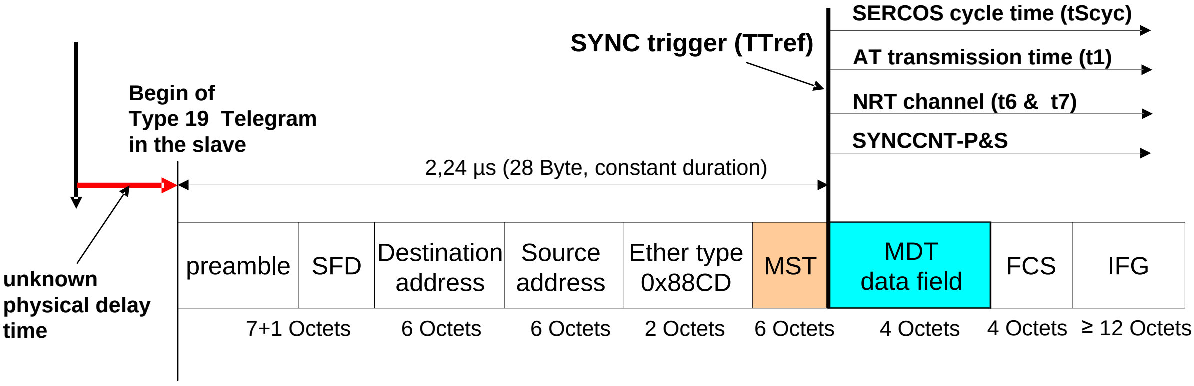
La synchronisation doit être générée une seule fois par cycle de communication uniquement par un MST valide (voir Figure 79). Un CRC supplémentaire assure la protection du MST. La fin du MST constitue le signal déclencheur de synchronisation (TTref) dans chaque cycle de communication (voir Figure 80).



Légende

Anglais	Français
Telegram timing of method 1 or method 2	Synchronisation de télégramme de la méthode 1 ou de la méthode 2
Communication cycle	Cycle de communication
Synchronization trigger once per communication cycle	Signal déclencheur de synchronisation une fois par cycle de communication

Figure 79 – Délai de synchronisation



Légende

Anglais	Français
Start of transmission in Master	Début de transmission dans le Maître
SYNC trigger	Signal déclencheur SYNC
SERCOS cycle time	Durée de cycle SERCOS
AT transmission time	Durée de transmission AT
UC channel	Canal UC
Begin of Type 19 telegram in the slave	Début de télégramme de Type 19 dans l'esclave
28 byte, constant duration	28 octets, durée constante

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Anglais	Français
Unknown physical delay time	Temps de retard physique inconnu
Preamble	Préambule
Destination address	Adresse de destination
Source address	Adresse source
Ether type	Ethertype
MDT data field	Champ de données MDT

Figure 80 – Signal déclencheur de synchronisation

7.2.1.2 Procédure d'acquisition du retard de l'anneau dans le maître

7.2.1.2.1 Généralités

Le maître doit envoyer des MST de manière cyclique dès qu'il quitte l'état NRT pour l'initialisation de la communication (CP0 à CP4). Il doit alors commencer à envoyer des trames MDT0 au début de chaque cycle de communication, avec une tolérance d'instabilité (instabilité MST). L'instabilité SYNC (S-0-1023) inclut l'instabilité MST.

La procédure d'acquisition du retard de l'anneau est identique pour la topologie en anneau et la topologie linéaire. Le maître doit contrôler les résultats de façon continue et les comparer aux valeurs correspondantes ayant été obtenues au cours de la dernière procédure achevée d'acquisition du retard de l'anneau. Le maître doit être capable d'émettre des avertissements si le retard physique mesurés éventuels diffère d'une valeur obtenue précédemment, de plus de la valeur et de la tolérance dépendant de l'application.

Le maître doit terminer la procédure d'acquisition du retard de l'anneau avant de transmettre aux esclaves le paramètre S-0-1015 Retard de l'anneau.

De plus, selon l'application, le maître peut activer cette procédure à tout moment de la phase CP3 ou CP4, c'est-à-dire à des fins de vérification de stabilité, ou lorsqu'il détecte des changements de topologie (retrait d'esclaves, connexion à chaud d'esclaves, reprise de l'anneau, etc.).

Pour la procédure d'acquisition du retard de l'anneau, le maître exécute les fonctions suivantes:

- mesurer le retard physique (tRing) de la topologie donnée,
- calculer le paramètre S-0-1015 Retard de l'anneau,
- transférer le paramètre S-0-1015 Retard de l'anneau à chaque esclave de synchronisation,
- activer la commande de procédure de mesure de retard SYNC (S-0-1024) dans chaque esclave de synchronisation.

Les paramètres de synchronisation suivants doivent être caractéristiques du réseau:

- trep – durée pour laquelle le signal reçu doit être reporté par une interface de Type 19 en mode acheminement rapide et bouclage avec acheminement (entrée vers sortie, environ 600 ns);
- tcable – durée pour laquelle le signal transmis est effectivement reporté par un câble (CAT5 max. 5,56 ns par mètre; fibre de verre, max. 5 ns par mètre);
- tRing – moyenne des temps de retard physique mesurés par le maître:
  $$\mathrm{tRing} = \sum \mathrm{tcable} + \sum \mathrm{trep}$$
- instabilité IFG – dépend des participants à la topologie, le maître doit déterminer l'instabilité IFG (voir S-0-1036 Espace entre trames);

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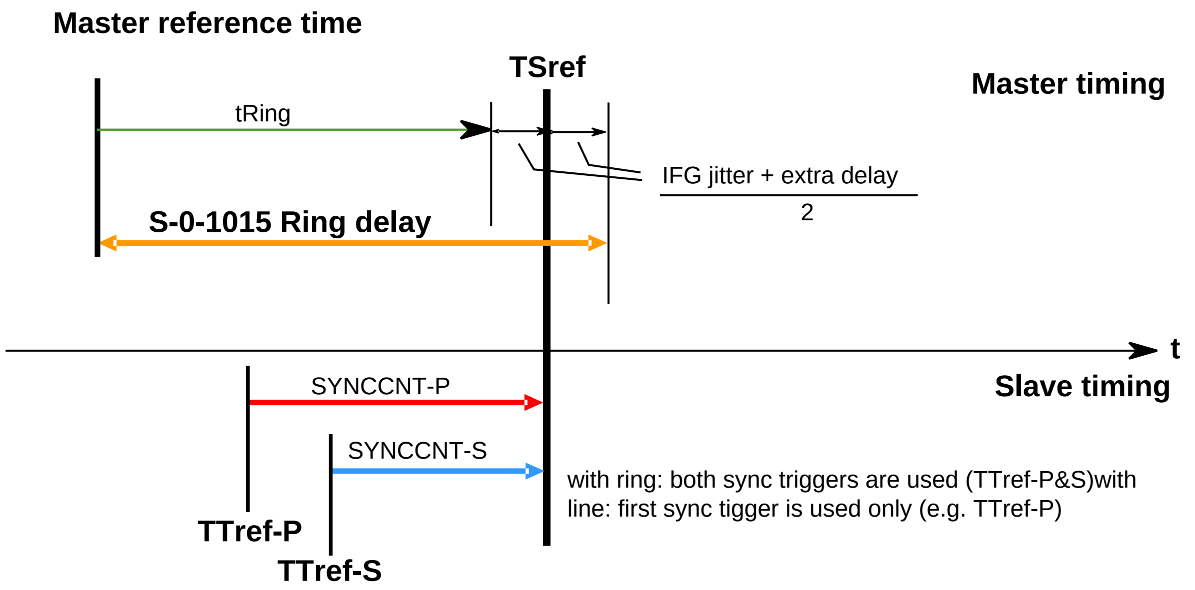
- Retard supplémentaire - retard supplémentaire défini ou calculé par le maître (par exemple, en cas de connexion à chaud des esclaves, retards du matériel du maître, etc.).

7.2.1.2.2 Détermination du retard de l'anneau avec topologie linéaire et en anneau

Le maître doit utiliser la même formule dans la topologie linéaire et la topologie en anneau. La topologie linéaire comporte un canal P ou un canal S. La topologie en anneau comporte les deux canaux (P et S). Synchronisation du maître et de l'esclave, voir Figure 81.

- Le maître doit mesurer au moins 64 fois les retards physiques du canal P (principal) et / ou S (secondaire), et détermine par ailleurs la moyenne (tRing) de toutes les mesures.
- Le maître doit déterminer l'instabilité IFG dépendant des participants à la topologie.
- Le maître peut ajouter un retard supplémentaire.
- Le maître calcule le retard de l'anneau pour une topologie linéaire ou en anneau donnée, à l'aide de la formule suivante: S-0-1015 Retard de l'anneau = tRing + instabilité IFG + retard supplémentaire.



Légende

Anglais	Français
Master reference time	Temps de référence du Maître
Master timing	Synchronisation maître
IFG jitter	Instabilité IFG
Extra delay	Retard supplémentaire
Ring delay	Retard de l'anneau
Slave timing	Synchronisation esclave
With ring: both sync triggers are used (Ttref-P&S) with line: first sync trigger is used only (e.g. Ttref-P)	Avec anneau: les deux déclencheurs de synchronisation sont utilisés (Tref-P&S) avec ligne: seul le premier déclencheur de synchronisation est utilisé (par exemple, Ttref-P)

Figure 81 – Synchronisation de TSref avec topologie en anneau et linéaire

7.2.1.2.3 Détermination du retard de l'anneau avec topologie en anneau interrompu

Ce calcul est nécessaire uniquement en phase CP2 si le maître commute sur une phase ascendante avec un anneau interrompu entre CP0 et CP4, et ferme l'anneau en CP4. Dans ce

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cas, le maître doit déterminer deux paramètres S-0-1015 Retard de l'anneau séparément. Un paramètre pour le canal P, et l'autre paramètre pour le canal S. Ceci doit être effectué pour maintenir synchrone le temps TSref des canaux P et S.

- Le maître doit mesurer au moins 64 fois les retards physiques du canal P et du canal S, et détermine par ailleurs la moyenne (tRing_P/S) séparément.
- Le maître doit déterminer séparément l'instabilité IFG dépendant des participants du canal P et du canal S (IFG jitter_P/S).
- Il doit également calculer extra delay_P/S pour maintenir synchrone le temps TSref du canal P et du canal S d'un anneau interrompu. La formule suivante est appliquée:

  tRing_P+(IFGjitter_P+extra delay_P)/2 = tRing_S+(IFG jitter_S + extra delay_S)/2
- Ce calcul permet de générer simultanément les temps de TSref pour le canal P et le canal S (voir Figure 82).

Après la reprise de l'anneau en CP3 et CP4:

- Le maître doit mesurer au moins 64 fois les retards physiques du canal P (principal) et / ou S (secondaire), et détermine par ailleurs la moyenne (tRing) de toutes les mesures. Le tRing mesuré peut être vérifié à l'aide de la formule suivante:

  tRing = (tRing_P + tRing_S)/2
- Le maître doit déterminer l'instabilité IFG dépendant des participants à la topologie.
- Il doit ajouter un retard supplémentaire prenant en compte l'une des formules suivantes.
  – (IFG jitter + extra delay)/2 = tRing_P+(IFGjitter_P+extra delay_P)/2- tRing
  – (IFG jitter + extra delay)/2 = tRing_S+(IFGjitter_S+extra delay_S)/2- tRing
- Le maître calcule le retard de l'anneau pour l'anneau donné afin de maintenir le temps TSref synchrone sur les canaux P et S précédents. Le temps TSref doit être constant pendant la reprise de l'anneau.
- Il doit également transmettre le retard de l'anneau (S-0-1015) à tous les esclaves de synchronisation. Ensuite, le maître doit activer S-0-1024 (Commande de procédure de mesure de retard SYNC) pour annoncer à l'esclave qu'il doit effectuer la synchronisation sur les deux ports.

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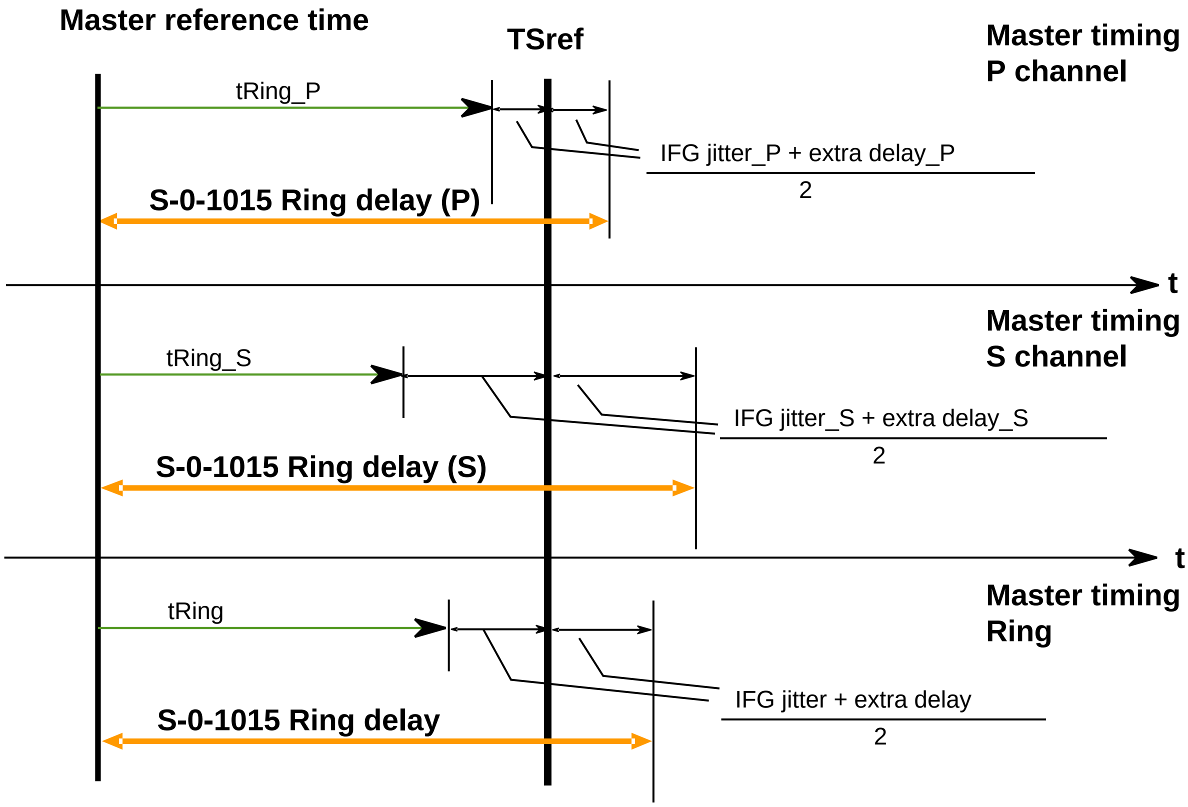

Légende

Anglais	Français
Master reference time	Temps de référence du Maître
Master timing P channel	Synchronisation maître – canal P
IFG jitter	Instabilité IFG
Extra delay	Retard supplémentaire
Ring delay	Retard de l'anneau
Slave timing S channel	Synchronisation esclave – canal S
Master timing ring	Synchronisation maître - anneau

Figure 82 – Synchronisation de TSref avec l'anneau interrompu

7.2.1.3 Acquisition du temps de référence de synchronisation dans l'esclave

Avec l'activation de la commande de procédure de mesure du retard SYNC (S-0-1024), l'esclave démarre la procédure d'acquisition du retard de l'anneau.

Comme illustré à la Figure 83, chaque esclave doit comporter les fonctions suivantes:

- Le retard de l'esclave (P&S) S-0-1016 contient deux compteurs SYNC (SYNCCNT-P/S) avec un compteur pour chaque port, tandis que chacun de ces compteurs doit commencer à compter à partir de zéro, si le port correspondant reçoit un MST.
- Un additionneur, qui constitue de manière continue la somme des deux valeurs de compteurs SYNC.
- Un comparateur, qui compare de manière continue la valeur d'état de l'additionneur (somme des deux valeurs de compteurs SYNC) avec la valeur du paramètre S-0-1015 Retard de l'anneau.

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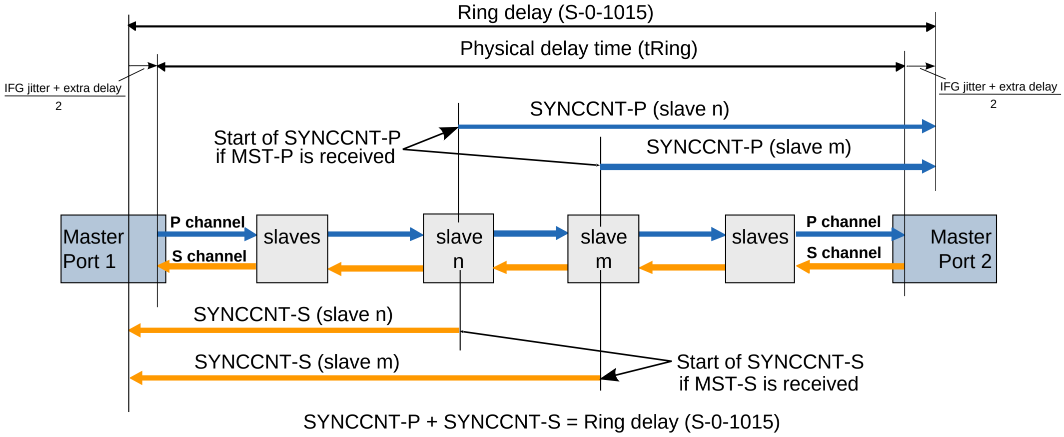
- Le comparateur associé à la somme indique que la somme des deux valeurs de compteurs SYNC a atteint une valeur supérieure ou égale à la valeur du retard de l'anneau. Dans ce cas, les deux valeurs de compteurs SYNC sont archivées dans le paramètre S-0-1016 Retard de l'esclave (P&S).
- L'esclave acquitte de manière positive la commande de procédure de mesure du retard SYNC (S-0-1024).
- Chaque esclave détermine 2 valeurs de compteurs SYNC dépendantes de l'ordre physique dans la topologie (SYNCCNT-P + SYNCCNT-S = S-0-1015 Retard de l'anneau).
- Le maître annule la commande de procédure de mesure du retard SYNC (S-0-1024).
- Avec la topologie en anneau:
  – ces 2 compteurs SYNC permettent la synchronisation de l'esclave.
  – la synchronisation de ce dernier doit s'effectuer sur les deux ports
- Avec la topologie linéaire:
  – le paramètre SYNCCNT avec la valeur inférieure est réglé sur 0 par l'esclave et n'est pas utilisé pour la synchronisation.
  – la synchronisation de l'esclave doit s'effectuer sur un seul port.



Légende

Anglais	Français
Ring delay	Retard de l'anneau
Physical delay time	Temps de retard physique
IFG jitter	Instabilité IFG
Extra delay	Retard supplémentaire
Start of SYNCCNT-P if MST-P is received	Début de SYNCCNT-P si MST-P est reçu
Slave	Esclave
Master port 1	Port 1 maître
Master port 2	Port 2 maître
P channel	Canal P
S channel	Canal S
Slaves	Esclaves
Start of SYNCCNT-S if MST-S is received	Début de SYNCCNT-S si MST-S est reçu

Figure 83 – Détermination du retard SYNC

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7.2.1.4 Synchronisation avec la topologie en anneau

Comme l'illustre la Figure 76 et la Figure 80, chaque esclave doit générer un signal déclencheur de synchronisation une seule fois par cycle de communication. L'esclave doit évaluer uniquement le MST sur les ports 1 et 2 pour synchronisation. L'en-tête SIII dans les télégrammes MDT1 à MDT3 et AT0 à AT3 ne doit pas être utilisé pour synchronisation.

Comme l'illustre la Figure 84, chaque esclave doit générer son temps de référence de synchronisation (TSref) dès que l'une des conditions suivantes est satisfaite:

- Le télégramme MST-P (canal principal) a été reçu sur un port, l'esclave a activé le temps de retard de synchronisation (SYNCCNT-P) et ce temps de retard a expiré, ou
- le télégramme MST-S (canal secondaire) a été reçu sur l'autre port, l'esclave a activé le temps de retard de synchronisation (SYNCCNT-S) et ce temps de retard a expiré.

L'esclave doit générer un temps de référence de synchronisation (TSref) uniquement dans un cycle de communication, dès que la première de ces conditions est satisfaite. Il peut ignorer le second signal déclencheur de synchronisation qui se produit ultérieurement dans le cycle de communication.

7.2.1.5 Synchronisation avec la topologie linéaire

A des fins de synchronisation, l'esclave doit évaluer le MST sur un seul port (port 1 ou port 2). L'en-tête SIII dans les télégrammes MDT1 à MDT3 et AT0 à AT3 ne doit pas être utilisé pour synchronisation.

L'esclave doit utiliser le port (1 ou 2) sur lequel il reçoit en premier le MST (ce port est plus proche du maître) et génère le signal déclencheur de synchronisation. Le port ayant reçu le MST ultérieurement, ne doit pas être utilisé pour le signal déclencheur de synchronisation.

Comme l'illustre la Figure 84, chaque esclave doit générer son temps de référence de synchronisation (TSref) dès que le premier MST (P ou S) a été reçu sur un port, l'esclave a activé le retard de synchronisation correspondant (SYNCCNT-P ou S) et ce temps de retard a expiré.

L'esclave doit générer uniquement un temps de référence de synchronisation (TSref) dans un cycle de communication. Il doit ignorer le second signal déclencheur de synchronisation qui se produit ultérieurement dans le cycle de communication.

7.2.1.6 Comportement de l'esclave en l'absence des signaux de synchronisation

Si un esclave ne reçoit pas de MST sur le port 1 ou le port 2 dans un cycle de communication, il doit alors

- générer un signal déclencheur de synchronisation interne pendant le cycle de communication.
- incrémenter le compteur d'erreurs MST interne une fois par cycle de communication.

Si un esclave génère un signal déclencheur de synchronisation interne en raison de l'absence de MST pendant plusieurs cycles de communication successifs, il doit alors se comporter tel que spécifié dans le paramètre S-0-1003 Pertes MST admises, dans les phases CP3&CP4.

7.2.1.7 Définitions du temps de référence de synchronisation et S-0-1007 Temps de synchronisation (Tsync)

Chaque esclave reçoit deux MST dans la topologie linéaire ou en anneau et obtient deux signaux déclencheurs de synchronisation. L'esclave choisit cependant uniquement le premier signal déclencheur de synchronisation reçu pour générer le temps de référence de synchronisation (TSref) (voir Figure 84). Si l'application nécessite un meilleur délai de

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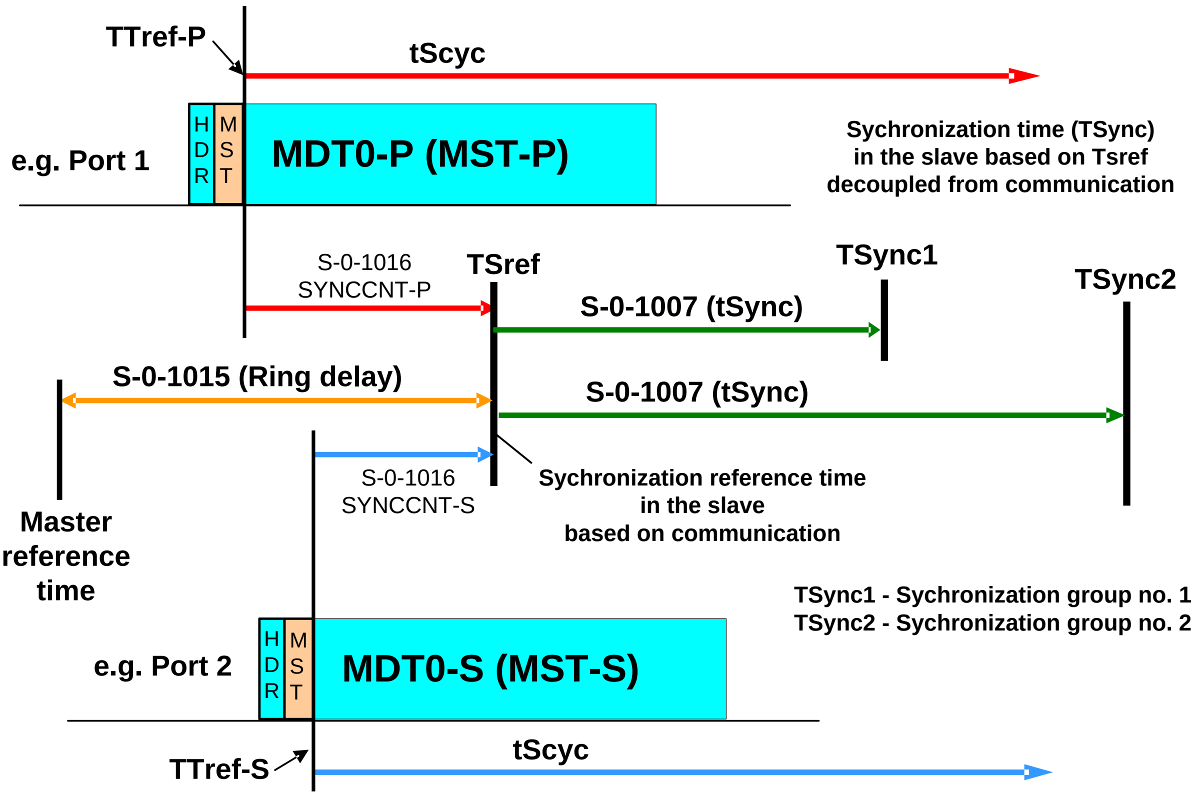
synchronisation, il est alors possible de lisser le temps de référence de synchronisation (TSref) au moyen d'une boucle numérique à verrouillage de phase (BNVP).

Le temps de référence de synchronisation (TSref) est basé sur la communication et est identique dans tous les esclaves synchronisés d'un réseau donné. Un réseau peut toutefois comporter plusieurs groupes de synchronisation avec un temps de synchronisation (TSync) (S-0-1007) différent selon l'application. Tous les esclaves synchronisés au sein d'un groupe de synchronisation doivent avoir le même temps de synchronisation (TSync) (S-0-1007).

Avec le temps de synchronisation (TSync) (S-0-1007), le maître peut ajuster au mieux les cycles de traitement de l'application dans l'unité de commande et dans les esclaves, par rapport à la synchronisation des télégrammes du cycle de communication. Par conséquent, les cycles de traitement de l'application sont découplés du cycle de communication, et le temps mort peut être réduit au minimum dans un circuit de commande en boucle fermée contenant la communication.



Légende

Anglais	Français
Synchronization time (TSync) in the slave based on Tsref decoupled from communication	Temps de synchronisation (TSync) dans l'esclave sur la base de Tsref découplé de la communication
e.g. Port 1	Par exemple, Port 1
Ring delay	Retard de l'anneau
Master reference time	Temps de référence du maître
Synchronization reference time in the slave based on communication	Temps de référence de synchronisation dans l'esclave sur la base de la communication
e.g. Port 2	Par exemple, Port 2
Synchronization group no. 1	Groupe de synchronisation n° 1
Synchronization group no. 2	Groupe de synchronisation n° 2

Figure 84 – Définition de TSref

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7.2.2 Synchronisation des cycles du producteur

7.2.2.1 Généralités

Les appareils esclaves ou maîtres de Type 19 sont capables de produire des connexions. Chaque connexion a sa propre Durée du cycle du producteur (tPcyc) (S-0-1050.x.10), qui peut être la durée de cycle de communication (tScyc, S-0-1002) ou un multiple de cette dernière. En l'absence de synchronisation, chaque producteur génère des données d'application de manière indépendante.

Les réseaux de Type 19 permettent de synchroniser ces connexions. Cela signifie que toutes les connexions synchronisées fournissent simultanément des données d'application de manière cyclique. L'en-tête de Type 19 de MDT0 (MST) constitue la base d'établissement de cet instant simultané. Toutes les connexions, ayant reçu le MST de synchronisation, se préparent à saisir les données d'application. Les connexions doivent attendre un certain moment, appelé le Temps de départ d'acquisition des données de contrôle par retour (S-0-1007 Temps de synchronisation (Tsync)), jusqu'à ce qu'elles saisissent les données en temps réel. Les connexions qui doivent être synchronisées doivent être configurées avec la même valeur T4pc. Lorsque la synchronisation de plusieurs connexions s'effectue avec la même valeur T4pc, cette dernière est également appelée TSync.

Pour pouvoir avoir différentes durées du cycle du producteur dans les connexions qui doivent être synchronisées, la valeur TSync n'apparaît pas nécessairement dans chaque cycle de communication. Cela signifie qu'il n'est pas nécessaire que chaque MST soit un MST de synchronisation (voir Figure 85).

- MaximumScycCnt = (LCM(tPcyc1,tPcyc2,tPcyc3,...) / tScyc) − 1

La période comprise entre deux TSync est appelée durée de cycle de synchronisation (tSync-cycle). Cette durée de cycle doit être déterminée compte tenu des durées du cycle du producteur utilisées. Le plus petit commun multiple (PPCM) de toutes les durées du cycle du producteur utilisées permet de définir tSync-cycle. Le calcul se présente comme suit:

tSync-cycle correspond à (Maximum ScycCnt +1) * tScyc.

Afin de mieux comprendre TSync et tSync-cycle, deux cas avec des valeurs tPcyc différentes sont pris en compte en 7.2.2.2 and 7.2.2.3:

7.2.2.2 La durée du cycle du producteur est un entier multiple de la durée de cycle de communication

Dans cet exemple, chaque producteur a différentes durées du cycle du producteur. Deux connexions avec des durées du cycle du producteur sont définies comme suit:

- tPcyc1 = 2x tScyc
- tPcyc2 = 3x tScyc

tSync-cycle est calculé comme suit:

- tSync − cycle = LCM(tPcyc1,tPcyc2) = 6 * tScyc

MST est utilisé comme base de synchronisation. Dans le cycle du producteur après TSync, les deux producteurs génèrent des données d'application de manière synchrone. Le second MST reçu dans la période tSync-cycle n'est pas utilisé à des fins de synchronisation. Ayant généré des données d'application de manière synchrone, chaque producteur continue à générer des données d'application en fréquence de sa durée du cycle du producteur. La synchronisation suivante s'effectue après tSync-cycle.

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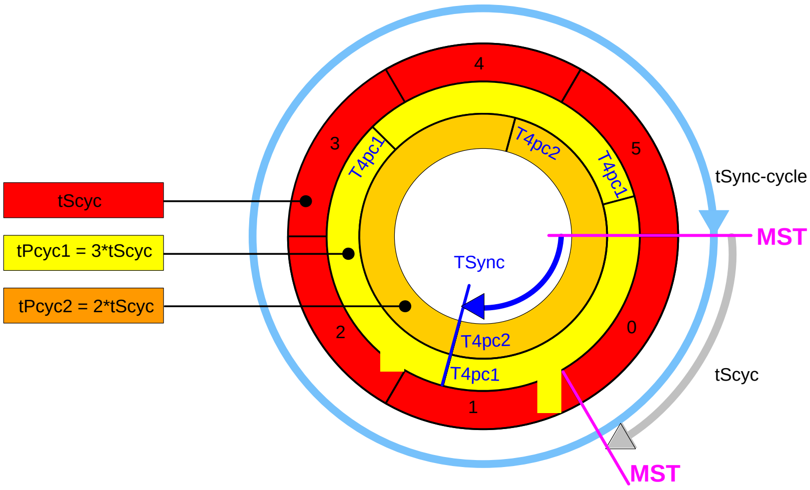

Figure 85 – Synchronisation avec différentes durées de cycle

7.2.2.3 La durée du cycle du producteur est égale à la durée de cycle de communication

Cet exemple illustre deux producteurs avec la même durée du cycle du producteur (tScyc = tPcyc1 = tPcyc2). Dans ce cas, chaque MST est utilisé à des fins de synchronisation (voir Figure 86). tSync-cycle est calculé comme suit:

- tSync − cycle = LCM(tPcyc1,tPcyc2) = 1 * tScyc

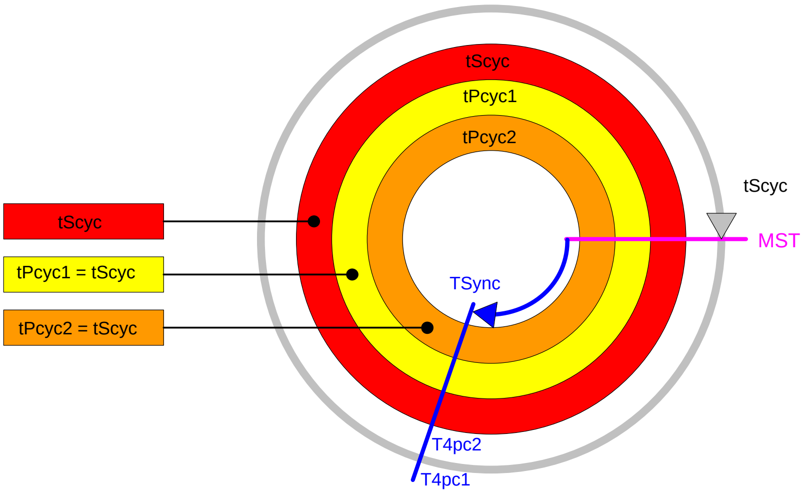

Figure 86 – Synchronisation avec les mêmes durées de cycle

7.3 Méthodes de traitement des données de connexion

7.3.1 Généralités

Trois méthodes de traitement des connexions sont spécifiées pour les réseaux de Type 19. Il s'agit des méthodes de

- traitement synchrone des données d'application
- traitement cyclique des données d'application
- traitement non synchrone des données d'application

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7.3.2 Traitement synchrone des données d'application dans l'esclave

La synchronisation du traitement synchrone est associée au temps de synchronisation (Tsync) (S-0-1007) et à chaque valeur T4pc définie par la durée du cycle du producteur (S-0-1050.x.10). La synchronisation du traitement des télégrammes est associée à la fin du MST (TTref). Le retard de synchronisation des télégrammes et synchrone est défini dans le Retard de l'esclave (P&S) (S-0-1016). Le retard de synchronisation (Time-del) est la différence de SYNCCNT-P et SYNCCNT-S (Time_del = SYNCCNT-P - SYNCCNT-S). Le délai du traitement synchrone des données d'application est présenté à la Figure 87.

- Traitement synchrone des données d'application chez le producteur: Les données d'application doivent être produites dans chaque cycle du producteur (tPcyc). Le temps de traitement des données du producteur (tmp-P) est spécifié dans S-0-1060.x.07 Temps maximal de traitement, respectivement S-0-1005 Temps minimal de traitement de contrôle par retour (t5). Le temps de traitement (tmp-P) doit commencer au temps T4pc, respectivement TSync.
  En fonction de la fonctionnalité, l'esclave doit soit utiliser le S-0-1005 Temps maximal de traitement du producteur (t5) pour toutes les connexions, soit le S-0-1060.x.07 Temps maximal de traitement pour chaque connexion séparément.
  - Cas 1 de production des données d'application Si la différence entre T1 et T4pc est supérieure ou égale au temps de traitement (tmp-P), compte tenu du retard de synchronisation (Time_del), les données d'application sont alors transmises dans le télégramme AT dans le même cycle de communication, tmp-P ou t5 ≤ t1 - Time_del - T4pc.
  - Cas 2 de production des données d'application: Si le temps de traitement (tmp-P) dure plus longtemps que le temps T1, les données d'application sont alors transmises dans le télégramme AT du cycle de communication suivant, tmp-P ou t5 > t1 - Time_del - T4pc.
- Traitement synchrone des données d'application chez le consommateur: Les données d'application doivent être consommées dans chaque cycle du producteur (tPcyc). Le temps de traitement des données du consommateur (tmp-C) est spécifié dans S-0-1060.x.07 Temps maximal de traitement, respectivement S-0-1047 Temps maximal d'activation du consommateur (t11). Il convient que le temps de traitement (tmp-C) s'achève avant le temps T4pc, respectivement TSync. La fin du bloc MDT est déterminée dans le calcul de la synchronisation des télégrammes.
  - Cas 1 de consommation des données d'application: Si la différence entre la Fin du bloc MDT et T4pc est supérieure ou égale au temps de traitement (tmp-C), compte tenu du retard de synchronisation (Time_del), les données d'application reçues sont alors activées au temps T4pc du même cycle de production, tmp-C ou t11 ≤ T4pc + Time_del - Fin du bloc MDT.
  - Cas 2 de consommation des données d'application:Si le temps de traitement (tmp-C) dure plus longtemps que le temps T4 pc, les données d'application reçues sont alors activées au temps T4pc du cycle du producteur suivant, tmp-C or t11 > T4pc + Time_del - Fin du bloc MDT).

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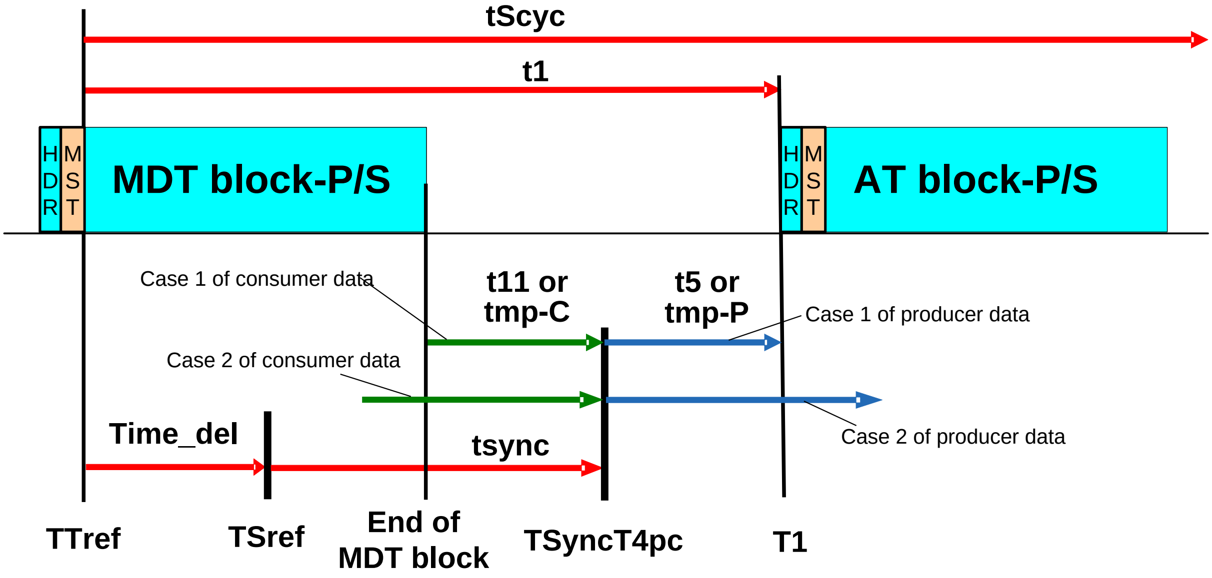

Légende

Anglais	Français
MDT block-P/S	Bloc MDT P/S
AT block-P/S	Bloc AT P/S
Case 1 of consumer data	Cas 1 de données de consommateur
Case 1 of producer data	Cas 1 de données de producteur
Case 2 of consumer data	Cas 2 de données de consommateur
Case 2 of producer data	Cas 2 de données de producteur
End of MDT block	Fin du bloc MDT

Figure 87 – Traitement synchrone des données d'application

7.3.3 Traitement cyclique des données d'application dans l'esclave

Le traitement cyclique est fondé sur le début et la fin du télégramme correspondant et doit être activé dans chaque Durée du cycle du producteur (S-0-1050.x.10). Le début et la fin du télégramme de Type 19 sont déterminés dans le calcul de synchronisation des télégrammes. La synchronisation du traitement des télégrammes est associée à la fin du MST (TTref). Le retard observé entre le télégramme P et le télégramme S est défini dans le Retard de l'esclave (P&S) (S-0-1016). Le retard de synchronisation (Time-del) est la différence de SYNCCNT-P et SYNCCNT-S (Time_del = SYNCCNT-P - SYNCCNT-S). La synchronisation du traitement cyclique des données d'application est présentée à la Figure 88.

- Traitement cyclique des données d'application chez le producteur: Les données d'application doivent être produites dans chaque cycle du producteur (tPcyc). Le temps de traitement des données du producteur (tmp-P) est spécifié dans S-0-1060.x.07 Temps maximal de traitement, respectivement S-0-1005 Temps minimal de traitement de contrôle par retour (t5).
  - Cas 1 de production des données d'application: Si le temps de traitement (tmp-P ou t5) s'achève avant que ne débute le télégramme de Type 19, les données d'application sont alors transmises dans ce télégramme de Type 19 de ce cycle de communication.
  - Cas 2 de production des données d'application: Si le temps de traitement (tmp-P ou t5) ne s'achève pas avant que ne débute le télégramme de Type 19, les données d'application sont alors transmises dans ledit télégramme du cycle de communication suivant.
- Traitement cyclique des données d'application chez le consommateur: Les données d'application doivent être consommées dans chaque cycle du producteur (tPcyc). Le

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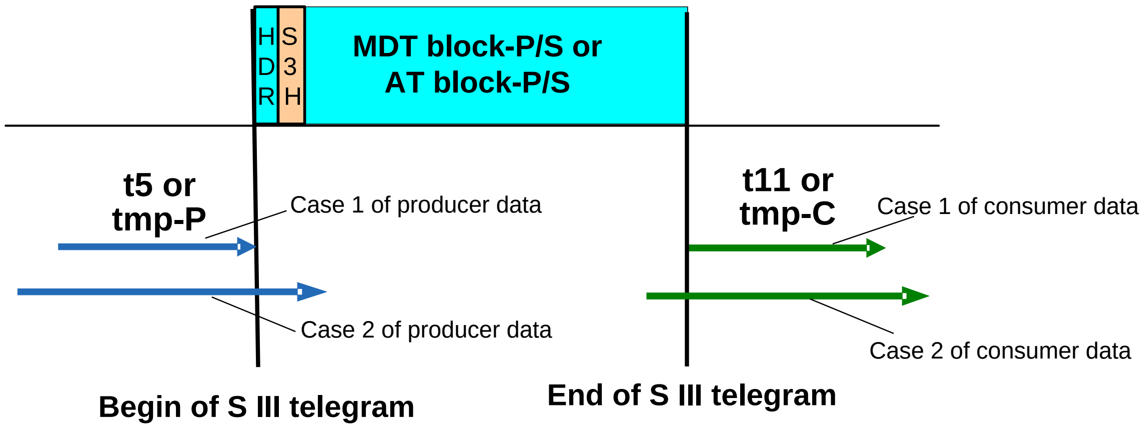
temps de traitement des données du consommateur (tmp-C) est spécifié dans S-0-1060.x.07 Temps maximal de traitement, respectivement S-0-1047 Temps maximal d'activation du consommateur (t11).

– Cas 1 de consommation des données d’application: Si le temps de traitement (tmp-C ou t11) débute après la fin du télégramme de Type 19, les données d’application reçues dans ledit télégramme sont alors activées dans le même cycle du producteur.
– Cas 2 de consommation des données d’application: Si le temps de traitement (tmp-C ou t11) débute avant la fin du télégramme de Type 19, les données d’application reçues dans ledit télégramme sont alors activées dans le cycle du producteur suivant. ce qui signifie que les données d’application du cycle du producteur précédent sont activées dans un cycle ultérieur du producteur.



Légende

Anglais	Français
MDT block-P/S or AT block-P/S	Bloc MDT P/S ou Bloc AT P/S
Case 1 of consumer data	Cas 1 de données de consommateur
Case 1 of producer data	Cas 1 de données de producteur
Case 2 of consumer data	Cas 2 de données de consommateur
Case 2 of producer data	Cas 2 de données de producteur
T5 or tmp-P	T5 ou tmp-P
T11 or tmp-C	T11 ou tmp-C
Begin of S III telegram	Fin du télégramme S III
End of S III telegram	Fin du télégramme S III

Figure 88 – Traitement cyclique des données d’application

7.3.4 Traitement non synchrone des données d’application dans l'esclave

Le traitement non synchrone n'utilise aucun paramètre de synchronisation. Le début et la fin du télégramme de Type 19 ne sont pas définis par des paramètres. Le retard observé entre le télégramme P et le télégramme S n'est pas défini. Le diagramme du traitement non synchrone des données d’application est présenté à la Figure 89.

Traitement non-synchrone des données d’application chez le producteur: Les données d’application peuvent être produites à tout moment, ce qui signifie qu'aucune durée du cycle du producteur n'est définie. La production des données d’application est aléatoire et le début du temps de traitement, ainsi que le temps de traitement proprement dit ne sont également pas définis.

Traitement non-synchrone des données d’application chez le consommateur: Les données d’application peuvent être consommées à tout moment, ce qui signifie qu'aucune durée du cycle du producteur n'est définie. La consommation des données d’application est aléatoire et

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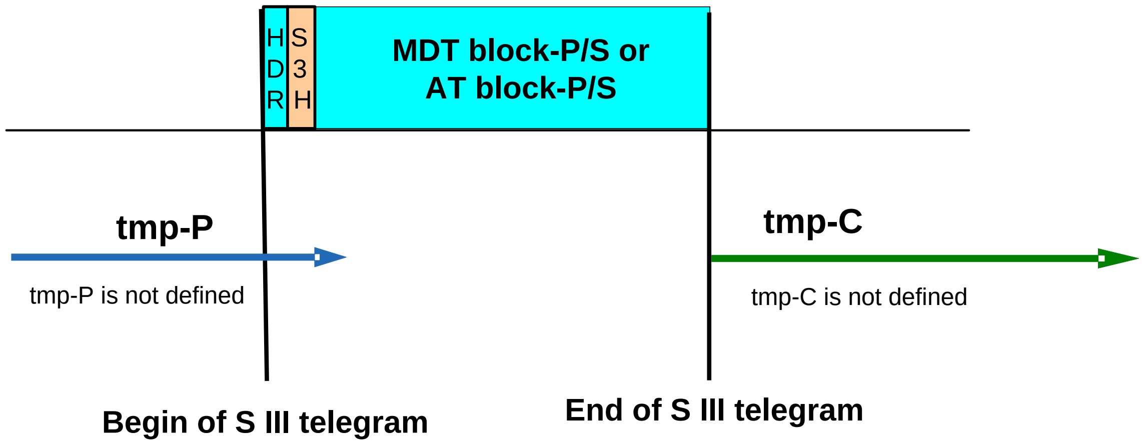
le temps de traitement des données d’application n'est également pas défini. Il est judicieux de commencer à consommer les données d’application uniquement si le télégramme de Type 19 correspondant a été reçu.



Légende

Anglais	Français
MDT block-P/S or AT block-P/S	Bloc MDT P/S ou Bloc AT P/S
Tmp-P is not defined	Tmp-P n'est pas défini
Tmp-C is not defined	Tmp-C n'est pas défini
Begin of S III telegram	Fin du télégramme S III
End of S III telegram	Fin du télégramme S III

Figure 89 – Traitement non-synchrone des données d’application

8 Traitement et contrôle d'erreur de communication

8.1 Télégrammes invalides

Le contenu des télégrammes MAC invalides ne doit pas être transmis aux sous-couches. L'occurrence de télégrammes MAC invalides peut être communiquée à la gestion de réseau. Les télégrammes MAC invalides peuvent être ignorés ou rejetés.

Un télégramme invalide doit être défini comme un télégramme satisfaisant au moins à l'une des conditions suivantes:

- Erreur d’alignement: Il ne s'agit pas d'un nombre entier d’octets en longueur.
- Erreur FCS: Les bits du télégramme entrant (à l'exception du champ FCS proprement dit) ne génèrent pas une valeur FCS identique à celle reçue.
- Erreur CRC: Les bits du télégramme entrant (à l'exception du champ CRC proprement dit de l'en-tête de Type 19) ne génèrent pas une valeur CRC identique à celle reçue.
- Erreur de longueur de télégramme de Type 19: Le télégramme n'a pas été reçu avec la longueur prévue.
- Perte de télégramme de Type 19: Le télégramme n'a pas été reçu dans le créneau prévu (par exemple, MST non reçu dans la fenêtre MST).

8.2 Réponse à une défaillance de télégrammes MDT et AT

En cas de défaillance d'un télégramme, le maître et l'esclave doivent répondre comme suit:

- la synchronisation de l'interface doit être préservée;

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- plusieurs compteurs (internes) doivent être incrémentés pour les télégrammes manquants.

Le profil d'application peut spécifier une réponse supplémentaire (par exemple, sur la base des dernières valeurs de commande correctes, un système d'entraînement doit calculer les valeurs de commande internes afin de remplacer les données du télégramme manquant, tel que spécifié dans FSP_Drive).

Le paramètre S-0-1003 (Pertes MST admises en CP3&CP4) définit le nombre maximal de cycles de communication au cours desquels un esclave peut ne pas recevoir ses télégrammes MST en phases CP3 et CP4. L'esclave doit recommuter des phases CP3 et CP4 sur l'état NRT lorsqu'il n'a pas reçu ses télégrammes MST selon le nombre supérieur à celui défini par l'utilisateur dans S-0-1003, et doit définir

- la valeur C1D d'erreur dans l'état d'appareil et
- le numéro de diagnostic S-0-0390 sur 0xC30F4001.

Une fois écoulée la moitié du nombre de cycles spécifiés dans S-0-1003, l'esclave doit définir

- le bit d'avertissement de communication dans son état d'appareil (bit 15) et
- le numéro de diagnostic S-0-0390 sur 0xC30E4001.

8.3 Compteurs d'erreurs dans l'esclave

Deux IDN sont définis et doivent être mis en œuvre dans les esclaves afin de diffuser le nombre d'erreurs reconnues dans ces mêmes esclaves:

- S-0-1028 Compteur d'erreurs MST-P&S: Cet IDN doit servir à présenter le nombre total de pertes effectives de télégrammes MST (MDT0).
- Port 1 & Port 2 du compteur d'erreurs ou S-0-1035: Cet IDN doit servir à présenter le nombre total de pertes effectives de télégrammes (télégrammes de Type 19 et télégrammes "autres que de Type 19").

8.3.1 Effets des erreurs sur les phases de communication

8.3.1.1 Phases de communication ascendantes

La séquence des phases de communication doit être maintenue dans l'ordre ascendant (0, 1-4). Lorsque cette séquence n'est pas maintenue, l'esclave doit revenir à l’état NRT.

L'esclave doit

- définir la valeur C1D d'erreur dans l'état d'appareil et
- régler le numéro de diagnostic S-0-0390 sur 0xC30F4004.

8.3.1.2 Phases de communication descendantes

Une modification des phases CP dans l'ordre descendant ne doit être effectuée que la CP0. La commutation des phases de communication entre CP0 et CP4 doit être effectué conformément à 5.2.

Lorsque le maître commute d'une CP supérieure à une CP inférieure autre que CP0, l'esclave doit alors revenir immédiatement au mode NRT et attendre la transmission de MDT0 de la phase CP0 par le maître.

L'esclave doit

- définir la valeur C1D d'erreur dans l'état d'appareil et
- régler le numéro de diagnostic S-0-0390 sur 0xC30F4005.

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8.4 Codes d'état du profil de communication de Type 19 (SCP)

Le présent article définit les codes d'état dédiés au profil de communication de Type 19 (SCP), utilisés pour la présentation neutre des informations de diagnostic des appareils esclaves de Type 19. Les classes de diagnostic et les codes d'état définis du profil SCP sont énumérés dans le Tableau 111 et le Tableau 112.

Tableau 111 – Codes d'état spécifiques SCP

Bit 31 - 20 Interprét. & Source (hex)	Classe de bits 19-16 (hex)	Code d'état bits 15-0 (hex)	Description
C30	A	0000	Phase de communication 0
C30	A	0001	Phase de communication 1
C30	A	0002	Phase de communication 2
C30	A	0003	Phase de communication 3
C30	A	0004	ce code d'état ne doit pas être utilisé
C30	A	0005	ce code d'état ne doit pas être utilisé
C30	A	0006	ce code d'état ne doit pas être utilisé
C30	A	0007	ce code d'état ne doit pas être utilisé
C30	A	0008	état NRT
C30	A	0009	ce code d'état ne doit pas être utilisé
C30	A	0030	Connexion à chaud phase 0 (HP0)
C30	A	0031	Connexion à chaud phase 1 (HP1)
C30	A	0032	Connexion à chaud phase 2 (HP2)
C30	C	0100	S-0-0127 Contrôle de transition de CP3 (Transition entre CP2 et CP3)
C30	C	0101	Paramètres invalides (Eléments de bloc de données nécessaires à la phase CP3 sont manquants ou invalides)
C30	C	0104	IDN configuré pour MDT non configurable
C30	C	0105	Longueur maximale pour MDT dépassée
C30	C	0106	IDN configurés pour AT non configurable
C30	C	0107	Longueur maximale pour AT dépassée
C30	C	0108	Paramètre de synchronisation > durée de cycle de Type 19 (tScyc) - t1, t6, t7, etc.
C30	C	0109	Décalage des télégrammes inadapté (par exemple, décalage de télégrammes hors des télégrammes, etc.)
C30	C	0110	ce code d'état ne doit pas être utilisé
C30	C	0111	ce code d'état ne doit pas être utilisé
C30	C	0112	ce code d'état ne doit pas être utilisé
C30	C	0113	ce code d'état ne doit pas être utilisé
C30	C	0114	ce code d'état ne doit pas être utilisé
C30	C	0115	ce code d'état ne doit pas être utilisé
C30	C	0116	ce code d'état ne doit pas être utilisé
C30	C	0139	ce code d'état ne doit pas être utilisé
C30	C	0170	IDN configurés pour connexion non configurable
C30	C	0171	Longueur maximale pour connexions dépassée
C30	C	0172	S-0-1024 Commande de procédure de mesure de retard SYNC non exécutée (Le maître n'a pas activé cette commande de procédure)
C30	C	0173	Le nombre des connexions n’est pas configurable

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Bit 31 - 20 Interprét. & Source (hex)	Classe de bits 19-16 (hex)	Code d'état bits 15-0 (hex)	Description
C30	C	0174	Configuration des connexions impossible
C30	C	0175	Durée du cycle du producteur (tPcyc) d'une connexion erronée
C30	C	0176	Classes SCP non correctes configurées (Classes SCP configurées ou leur combinaison dans S-0-1000.0.1 Liste des classes SCP Actives & Version SCP n'est pas prise en charge par l'esclave)
C30	C	5200	S-0-0128 Contrôle de transition de CP4 (Transition entre CP3 et CP4)
C30	C	5300	Commande de procédure de mesure de retard SYNC ou S-0-1024
C30	C	5301	S-0-1024 Echec de la commande de procédure de mesure de retard SYNC (S-0-1015 Retard de l'anneau = 0 ou S-0-1015 Retard de l'anneau invalide = 0 ou invalide)
C30	C	5302	S-0-1024 Erreur de la commande de procédure de mesure de retard SYNC (Interruption ou perturbation de la mesure ou S-0-1015 Retard de l'anneau est trop faible)
C30	C	0	réservé
C30	E	4001	Avertissement de pertes MST (le nombre de pertes MST correspond à la moitié de S-0-1003 en CP3 & CP4)
C30	E	4002	arrêt de défaillance RTD
C30	E	4003	phase de communication invalide reconnue
C30	E	4004	séquence de CP lors de la commutation ascendante de phase n'est pas correcte
C30	E	4005	séquence de CP lors de la commutation descendante de phase n'est pas correcte
C30	E	4006	Le maître modifie la CP actuelle avec MST.Phase.CPS = 0
C30	E	4007	Echec de la connexion du consommateur
C30	E	4008	Adressage invalide du conteneur A de données MDT
C30	E	4009	Adressage invalide du conteneur A de données AT
C30	E	4010	réservé
C30	E	4019	CPS=1 et le maître modifie la CP en une valeur invalide (voir 5.2.3.4)
C30	E	4020	L'état de topologie passe d'un acheminement rapide (FF) à un bouclage avec acheminement (L&F) - supprimé lors du changement de L&F à FF (se produit lors du changement de FF à L&F, supprimé lors du changements de L&F à FF)
C30	E	0	réservé
C30	F	4001	Erreur de pertes MST (Dépassement du nombre de pertes MST en CP3 & CP4. L'esclave commute sur le mode NRT (voir 5.2.3.4)
C30	F	4002	pertes de connexion (nombre de pertes de données > S-0-1050.x.11 en CP4. voir 4.7)
C30	F	4003	réservé pour le Type 16
C30	F	4004	réservé pour le Type 16
C30	F	4005	réservé pour le Type 16
C30	F	4006	réservé (ce code d'état ne doit pas être utilisé)
C30	F	4017	La temporisation CPS-MST (500 ms) se produit lors de la commutation de phase (voir 5.2.3.4)
C30	F	4018	Les données du producteur OVS ne sont pas valides
C30	F	4019	CPS=0 et le maître modifie la CP en une valeur invalide (voir 5.2.3.4)
C30	F	4020	L'état de topologie passe du bouclage avec acheminement au mode NRT (se produit si le câble est rompu sur le port actif)
C30	F	4021	L'esclave ne prend pas en charge la version de communication annoncée pour les phases CP1 et CP2

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Bit 31 - 20 Interprét. & Source (hex)	Classe de bits 19-16 (hex)	Code d'état bits 15-0 (hex)	Description
C30	F	4022	réservé
C30	F	4023	réservé
C30	F	0	Réservé

8.5 Priorité des classes de diagnostic

Le Type 19 définit les classes de diagnostic suivantes, utilisées pour catégoriser les informations de diagnostic selon leur contexte et influence sur l'état d'erreur de l'appareil et ses composants.

Chaque classe de diagnostic a une priorité spécifique, utilisée à des fins de hiérarchisation par ordre de priorité.

En général, l'attribution de classes de diagnostic aux informations de diagnostic particulières est spécifique au constructeur.

Tableau 112 – Présentation des classes de diagnostic

Classe de diagnostic	Priorité	Description
Etat de fonctionnement	4 (valeur la plus faible)	Informations de diagnostic, représentant un événement ou un état, qui n'impliquent aucune menace pour l'appareil ou le composant, par exemple, "Asservissement de couple" ou "remplacement compatible d'un module ES'.
Etat spécifique à la commande de procédure	3	Informations de diagnostic, générées lors de l'exécution d'une commande de procédure et qui peuvent clairement être affectées à cette commande, par exemple, “S-0-0420 Activer la commande de procédure de niveau de paramétrage (PL)" exécutée ou “marque de référence non détectée”
Avertissement (C2D)	2	Informations de diagnostic, représentant un événement ou un état, qui impliquent une menace pour l'appareil ou le composant, par exemple, "Avertissement de surchauffe du moteur" ou "sous-tension de certains composants d'appareil'.
Erreur (C1D)	1 (valeur la plus élevée)	Informations de diagnostic, représentant un événement ou un état, qui impliquent une défaillance du système, "perte de référence du codeur du moteur" ou "dysfonctionnement du bus local'.
Etat de fonctionnement	4 (valeur la plus faible)	Informations de diagnostic, représentant un événement ou un état, qui n'impliquent aucune menace pour l'appareil ou le composant, par exemple, "Asservissement de couple" ou "remplacement compatible d'un module ES'.

Dans les cas suivants cependant, le Type 19 impose les classes de diagnostic qu’il faut affecter aux informations de diagnostic:

- Lorsque les informations de diagnostic sont spécifiques à une commande de procédure, il faut qu’elles soient affectées à la classe de diagnostic "état spécifique de commande de procédure".
- Si les informations de diagnostic influent généralement sur l'état d'erreur d'un composant, le Type 19 affecte ces dernières de manière fixe à la classe de diagnostic correspondante par la description des codes d'état.

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Annexe A
(normative)

IDN – Numéros d'identification

A.1 Spécification des IDN

A.1.1 Introduction

Tous les paramètres doivent être affectés aux IDN.

Chaque paramètre est constitué d'éléments. Les éléments sont utilisés pour fournir des informations supplémentaires requises pour l'affichage et la saisie de données, ainsi que pour l'utilisation de programmes universels à l'aide du terminal de commande. Ces informations supplémentaires sont nécessaires au traitement de données liées arbitrairement aux esclaves. Avec ces informations, un paramètre anonyme peut être interprété par l'interface utilisateur. La structure des paramètres doit être telle que présentée dans le Tableau A.1. Dans tout paramètre, les éléments 1, 3 et 7 sont obligatoires et doivent toujours être présents. Les éléments 2, 4, 5 et 6 sont facultatifs et peuvent être pris en charge selon la configuration. Les éléments 5 et 6 sont obligatoires pour les seuls paramètres de la durée de cycle. Les éléments appropriés des paramètres doivent être sélectionnés par les bits de contrôle de la voie de service.

Champ d'application d'un paramètre (général / local)

Cet aspect du champ d'application d'un paramètre est pertinent uniquement lorsqu'un appareil est constitué de plusieurs sous-appareils. Il existe deux champs d'application différents des paramètres, à savoir général et local.

- Les paramètres généraux sont uniques dans un appareil donné. Les modifications d'un paramètre général d'un sous-appareil entraînent des modifications de tous les autres sous-appareils de l'appareil. Par exemple, l'adresse IP est unique dans un appareil donné. Chaque sous-appareil doit comporter un paramètre général.
- Les paramètres locaux sont uniques dans un sous-appareil donné. Un paramètre local peut exister uniquement dans un sous-appareil donné.

Tableau A.1 – Structure des blocs de données

N° d'élément	Description	Exigence
1	IDN	Obligatoire
2	Nom	Facultatif
3	Attribut	Obligatoire
4	Unité	Facultatif
5	Valeur d'entrée minimale	Facultatif
6	Valeur d'entrée maximale	Facultatif
7	Données d'exploitation	Obligatoire
NOTE Les éléments 5 et 6 sont obligatoires pour les paramètres de la durée de cycle (S-0-1050.x.10, S-0-1002).		

A.1.2 Elément 1: structure d'un IDN

Lorsqu'elles sont écrites et lues par l'intermédiaire des voies de service, les données appropriées doivent être adressées au moyen des IDN. D'autre part, les données

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d'exploitation, contenues dans la partie configurable des enregistrements de données des télégrammes AT et MDT, doivent être telles que définies au moyen des IDN.

La numérotation des IDN doit couvrir un intervalle de 2^{32}, qui doit être subdivisé comme suit:

- Deux intervalles doivent être disponibles pour les IDN standard et les IDN spécifiques au produit. Ces derniers ne relèvent pas de la normalisation.
- Chaque intervalle doit être subdivisé en huit ensembles de paramètres.
- Chaque groupe doit ainsi comporter jusqu'à 4 095 numéros de blocs de données ou groupes de fonctions.
- Chaque IDN peut comporter jusqu'à 256 instances de structure et jusqu'à 256 éléments de structure.

Les IDN doivent être transférés dans les télégrammes sous forme de nombres binaires à 32 bits.

Le Tableau A.2 décrit la structure des IDN.

Tableau A.2 – Structure des paramètres

Numéro de bit	Valeur	Description
31-24	—	Instance de structure (SI)
	0-255	Nombre d'instances de structure (SI)
23-16	—	Elément de structure (SE)
	0 -127 (bit 23 = 0)	SE standard (bit 15 = 0) déterminé par le Type 19 (bit 15 = 0)
	128 -255 (bit 23 = 1)	SE spécifique au produit déterminé par le constructeur (bit 15 = 0)
15	—	Données standard ou spécifiques au produit (S ou P)
	0	IDN standard (S-0-nnnn), SE (0-127), SI et numéro de bloc de données déterminés par le Type 19
	1	IDN spécifique au produit (P-0-nnnn), Bits 31 à 0 déterminés par le constructeur
14-12	—	Ensembles de paramètres
	0-7	Ensemble de paramètres 0 - 7 (le Type 19 spécifie des IDN avec l'ensemble de paramètres 0 uniquement.)
11-0	—	Bloc de données ou groupe de fonctions
	0-4095	Numéro de bloc de données (si SI = SE = 0); Groupe de fonctions (si SI ou SE différent de 0)

La notation d'un IDN doit se présenter comme suit:

- En l'absence de SE ou de SI, la notation doit être: S/P - Ensemble de paramètres - Numéro de bloc de données (par exemple S-0-1002)
- En présence de SE ou de SI, la notation doit être: S/P - Ensemble de paramètres - Groupe de fonctions. SI. SE (par exemple, S-0-1300.0.2)

A.1.3 Elément 2: Structure de nom

Le nom doit comprendre deux spécifications de longueurs de deux octets chacune et une chaîne de caractères de 60 caractères UTF8 (au maximum 240 octets). Les octets 1 et 2 du nom doivent spécifier la longueur de texte actuelle en octets. Les octets 3 et 4 du nom doivent indiquer la longueur maximale de texte en octets dans un esclave.

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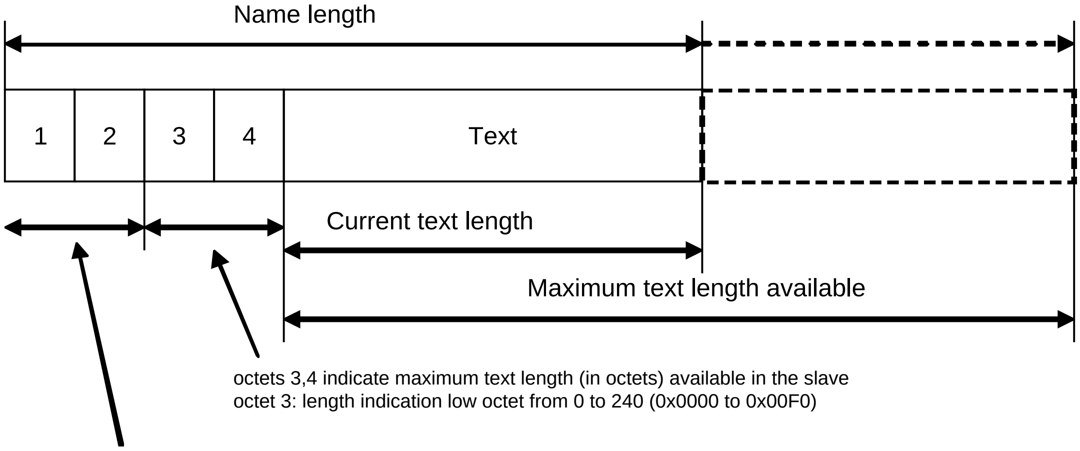
La Figure A.1 présente la structure de nom des IDN.



Légende

Anglais	Français
Name length	Longueur de nom
Text	Texte
Current text length	Longueur de texte actuelle
Maximum text length available	Longueur maximale de texte disponible
Octets 3, 4 indicate maximum text length (in octets) available in the slave octet 3: length indication low octet from 0 to 240 (0x0000 to 0x00F0)	Les octets 3, 4 indiquent la longueur maximale de texte (en octets) disponible dans l'esclave Octet 3: octet de poids faible d'indication de longueur de 0 à 240 (0x0000 à 0x00F0)

Figure A.1 – Structure de nom des IDN

Si la longueur actuelle du texte est égale à 0, seules les deux indications concernant la longueur doivent être transmises. Les octets 1 et 2 doivent alors contenir la valeur 0.

Lecture: Afin d'achever une commande de lecture dans la voie de service, le maître doit exiger la présence des octets 1 et 2. Les octets 3 et 4 doivent être lus uniquement par le maître afin d'éviter la saisie d'un texte trop long.

Ecriture: Lors de la saisie d'un nom, le maître doit régler les octets 1 et 2 selon la longueur actuelle du texte. La longueur du texte ne doit pas être supérieure à celle spécifiée dans les octets 3 et 4. Lors de l'écriture, l'esclave doit ignorer les octets 3 et 4 et intégrer sa longueur disponible lors de la lecture.

A.1.4 Elément 3: structure d'attribut

Chaque paramètre doit avoir un attribut qui permet une représentation intelligible des diverses données d'exploitation au moyen de programmes universels. L'attribut doit contenir toutes les informations nécessaires pour l'affichage intelligible des données d'exploitation. L'attribut permet la conversion de données d'exploitation transférées en données d'affichage intelligibles et réciproquement. La conversion ne doit avoir aucun impact sur les données proprement dites. Si les données nécessitent une mise à l'échelle, des paramètres spécifiques de mise à l'échelle doivent être prévus. Chaque changement d'échelle nécessite une modification des attributs des données concernées. Il est recommandé que l'attribut soit protégé en écriture (voir Tableau A.3).

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Tableau A.3 – Elément 3 des IDN

Numéro de bit	Valeur	Description
31	—	(réservé)
30	—	Protégé en écriture en CP4
	0	Données d'exploitation inscriptibles
	1	Données d'exploitation protégées en écriture
29	—	Protégé en écriture en CP3
	0	Données d'exploitation inscriptibles
	1	Données d'exploitation protégées en écriture
28	—	Protégé en écriture en CP2
	0	Données d'exploitation inscriptibles
	1	Données d'exploitation protégées en écriture
27-24	—	Virgule décimale: Il s'agit d'informations d'affichage supplémentaires. Les chiffres après la virgule décimale indiquent la position de la virgule décimale pour l'affichage et l'entrée des données d'exploitation appropriées. La virgule décimale sert à l'affichage d'une décimale signée et non signée. Pour tous les autres formats d'affichage, la virgule décimale doit être = 0
	0000 à 1111	Aucun emplacement pour 15 chiffres (au maximum) après la virgule décimale
23	—	(réservé)
22-20	—	Type de données et format d'affichage. Le type de données et le format d'affichage sont utilisés pour convertir les données d'exploitation et les valeurs minimale et maximale d'entrée en format d'affichage correct.
	000	Type de données: Nombre binaire Format d'affichage: Binaire
	001	Type de données: Entier non signé Format d'affichage: Décimale non signée
	010	Type de données: Entier Format d'affichage: Décimale signée
	011	Type de données: Entier non signé Format d'affichage: Hexadécimal
	100	Type de données: Jeu de caractères étendu Format d'affichage: Texte (ASCII)
	101	Type de données: Entier non signé Format d'affichage: IDN
	110	Type de données: Nombre à virgule flottante Format d'affichage: Décimale signée avec exposant (virgule flottante) Simple ou double précision, selon la norme ANSI/IEEE 752-1995
	111	Type de données: Heure de Type 19 Format d'affichage: selon la CEI 61588, 4 octets secondes & 4 octets nanosecondes, commence à la date du 1.1.1970, calculée en TUC
19	—	Le paramètre est le suivant:
	0	N'est pas une commande de procédure
	1	une commande de procédure
18-16	—	Longueur de données: La longueur des données est requise pour que le maître soit capable d'effectuer correctement des transferts de données de la voie de service
	000	(réservé)
	001	La longueur des données d'exploitation est de deux octets
	010	La longueur des données d'exploitation est de quatre octets
	011	La longueur des données d'exploitation est de huit octets
	100	Longueur variable avec chaînes de données à un octet

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Numéro de bit	Valeur	Description
	101	Longueur variable avec chaînes de données à deux octets
	110	Longueur variable avec chaînes de données à quatre octets
	111	Longueur variable avec chaînes de données à huit octets
15-0	—	Facteur de conversion: entier non signé destiné à convertir des données numériques en format d'affichage. Le facteur de conversion doit être réglé sur une valeur de 1 lorsqu'il n'est pas nécessaire pour l'affichage des données (par exemple: en cas de nombre binaire, de chaîne de caractères ou de nombre à virgule flottante, etc.)

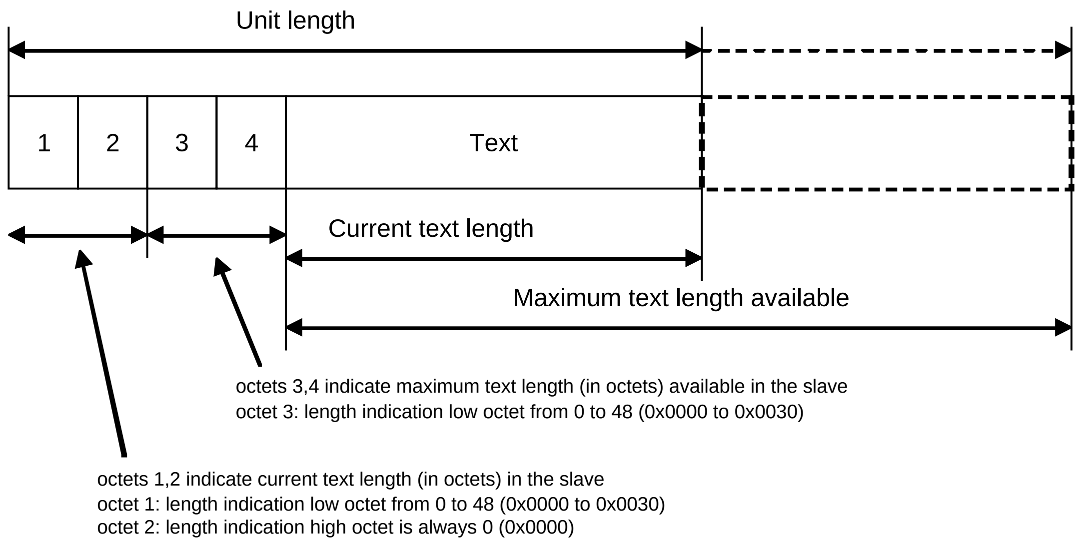
Les formats d'affichage et la longueur des données doivent présenter l'une des combinaisons valides (marquées par un "oui") du Tableau A.4.

Tableau A.4 – Combinaisons valides des formats d'affichage

Longueur de données	Binaire	Décimale non signée	Décimale signée	Hex	Texte	IDN	Virgule flottante	Durée
2 octets	oui	oui	oui	oui				
4 octets	oui	oui	oui	oui		oui	oui	
8 octets	oui	oui	oui	oui			oui	oui
liste à 1 octet	oui	oui	oui	oui	oui			
liste à 2 octets	oui	oui	oui	oui				
liste à 4 octets	oui	oui	oui	oui		oui	oui	
liste à 8 octets	oui	oui	oui	oui			oui	oui

A.1.5 Elément 4: structure d'unité

L'unité doit comprendre deux spécifications de longueurs de deux octets chacune et une chaîne de caractères de 12 caractères UTF8 (au maximum 48 octets). Les octets 1 et 2 de l'unité doivent spécifier la longueur de texte actuelle en octets. Les octets 3 et 4 de l'unité doivent indiquer la longueur maximale de texte en octets dans un esclave. Un paramètre ne doit comporter aucune unité, si le type de données est un nombre binaire ou une chaîne de caractères. Voir Figure A.2.



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Légende

Anglais	Français
Unit length	Longueur d'unité
Text	Texte
Current text length	Longueur de texte actuelle
Maximum text length available	Longueur maximale de texte disponible
Octets 3, 4 indicate maximum text length (in octets) available in the slave octet 3: length indication low octet from 0 to 240 (0x0000 to 0x00F0)	Les octets 3, 4 indiquent la longueur maximale de texte (en octets) disponible dans l'esclave Octet 3: octet de poids faible d'indication de longueur de 0 à 240 (0x0000 à 0x00F0)
Octets 1, 2 indicate current text length (in octets) in the slave	Les octets 1, 2 indiquent la longueur de texte actuelle (en octets) dans l'esclave
Octet 1: length indication octet low octet from 0 to 48 (0x0000 to 0x0030)	Octet 1: octet de poids faible d'indication de longueur de 0 à 48 (0x0000 à 0x0030)
Octet 2: length indication high octet is always 0 (0x0000)	Octet 2: l'octet de poids fort d'indication de longueur est toujours 0 (0x0000)

Figure A.2 – Structure d'unité

Si la longueur actuelle du texte est égale à 0, seules les deux indications concernant la longueur doivent être transmises. Les octets 1 et 2 doivent alors contenir la valeur 0.

Lecture: Afin d'achever une commande de lecture dans la voie de service, le maître doit exiger la présence des octets 1 et 2. Les octets 3 et 4 doivent être lus uniquement par le maître afin d'éviter la saisie d'un texte trop long.

Ecriture: Lors de la saisie d'une unité, le maître doit régler les octets 1 et 2 selon la longueur actuelle du texte. La longueur du texte ne doit pas être supérieure à celle spécifiée dans les octets 3 et 4. Lors de l'écriture, l'esclave doit ignorer les octets 3 et 4 et intégrer sa longueur disponible lors de la lecture.

A.1.6 Elément 5: structure de valeur minimale

La valeur d'entrée minimale doit être la valeur numérique la plus petite pour les données d'exploitation que l'esclave est capable de traiter et avoir la même longueur que les données d'exploitation.

Lorsque l'esclave ignore la demande d'écriture des données d'exploitation, il doit renvoyer, et uniquement dans ce cas, le code d'erreur correspondant et régler le bit d'erreur de données SVC dans l'état SVC.

Les types de données suivants n'ont pas de valeur d'entrée minimale:

- nombre binaire
- chaîne de caractères
- IDN.

La valeur d'entrée minimale doit être affichée comme les données d'exploitation.

Il est recommandé que la valeur d'entrée minimale soit protégée en écriture.

A.1.7 Elément 6: structure de valeur maximale

La valeur d'entrée maximale doit être la valeur numérique la plus grande pour les données d'exploitation que l'esclave est capable de traiter, et a la même longueur que les données d'exploitation.

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Lorsque l'esclave ignore la demande d'écriture des données d'exploitation, il doit renvoyer, et uniquement dans ce cas, le code d'erreur correspondant et régler le bit d'erreur de données SVC dans l'état SVC.

Lorsque les données d'exploitation sont un nombre binaire, les bits pris en charge sont alors réglés sur la valeur d'entrée maximale. Le maître reconnaît par conséquent les bits pris en charge par l'esclave dans ce paramètre.

Les types de données suivants n'ont pas de valeur d'entrée maximale:

- chaîne de caractères et
- IDN.

La valeur d'entrée maximale doit être affichée comme les données d'exploitation.

Il est recommandé que la valeur d'entrée maximale soit protégée en écriture.

A.1.8 Elément 7: structure des données d'exploitation

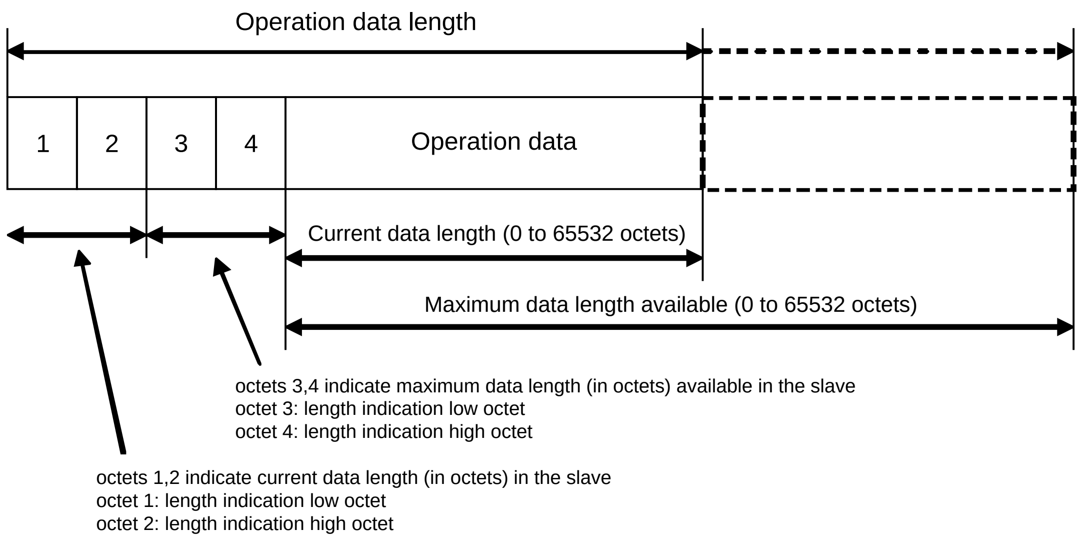
Lors de la saisie des données d'exploitation d'un IDN, qui est un champ binaire, l'esclave doit masquer les données d'exploitation saisies à l'aide du masque des bits pris en charge (que l'esclave peut présenter par la valeur maximale de l'IDN), puis traiter les données saisies.

Les données d'exploitation doivent avoir l'une des longueurs suivantes:

- longueur fixe avec deux octets;
- longueur fixe avec quatre octets;
- longueur fixe avec huit octets;
- longueur variable avec les éléments de liste de 1, 2, 4 et 8 octets jusqu'à 65 532 octets.

Longueur variable

Les spécifications de longueur variable uniquement doivent être codées dans les quatre premiers octets pour les chiffres hexadécimaux. La structure des données d'exploitation de longueur variable doit être telle qu'illustrée à la Figure A.3.



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Légende

Anglais	Français
Operation data length	Longueur de données d'exploitation
Operation data	Données d'exploitation
Current data length (0 to 65532 octets)	Longueur de données actuelle (0 à 65532 octets)
Maximum data length available (0 to 65532 octets)	Longueur maximale de données disponible (0 à 65532 octets)
Octets 3, 4 indicate maximum data length (in octets) available in the slave octet 3: length indication low octet	Les octets 3, 4 indiquent la longueur maximale de données (en octets) disponible dans l'esclave Octet 3: octet de poids faible d'indication de longueur
octet 4: length indication high octet	Octet 4: octet de poids fort d'indication de longueur
Octets 1, 2 indicate current data length (in octets) in the slave	Les octets 1, 2 indiquent la longueur de données actuelle (en octets) dans l'esclave
Octet 1: length indication octet low octet	Octet 1: octet de poids faible d'indication de longueur
Octet 2: length indication high octet	Octet 2: octet de poids fort d'indication de longueur

Figure A.3 – Structure des données d'exploitation IDN de longueur variable

Les données d'exploitation de longueur variable doivent se composer d'indicateurs de longueur dans les 4 premiers octets, suivis des données d'exploitation programmées.

Des fichiers ou des tables doivent être chargés dans les esclaves à partir de l'unité de commande et réciproquement, au moyen du transfert des données d'exploitation de longueur variable (par exemple, la liste des IDN de toutes les données d'exploitation dans un esclave).

Si la longueur des données d'exploitation est égale à 0, seules les deux indications concernant la longueur doivent être transmises. Les octets 1 et 2 doivent alors contenir la valeur 0.

Lecture: Afin d'achever correctement une commande de lecture dans la voie de service, le maître doit exiger la présence des octets 1 et 2. Les octets 3 et 4 doivent être lus uniquement par le maître afin d'éviter la saisie de données d'exploitation trop longues.

Ecriture: Lors de la saisie des données d'exploitation, le maître doit régler les octets 1 et 2 selon la longueur actuelle des données. La longueur des données ne doit pas être supérieure à celle spécifiée dans les octets 3 et 4. Lors de l'écriture, l'esclave doit ignorer les octets 3 et 4 et intégrer sa longueur disponible lors de la lecture.

Tri des IDN dans les listes correspondantes:

Les IDN doivent être triés dans les listes des IDN correspondantes selon l'une des méthodes suivantes:

- Listes des IDN non triés (par exemple, listes de configuration)
- Listes triées par groupe de fonctions ou numéro de blocs de données (FG)
  - Groupe de fonctions ou numéro de blocs de données
  - Instance de structure,
  - Elément de structure.
- Listes triées par instance de structure (SI)
  - Instance de structure,
  - Groupe de fonctions ou numéro de blocs de données
  - Elément de structure.

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Le Tableau A.5 présente un exemple de structure d'une liste des IDN et de tri des IDN.

Tableau A.5 – Exemple de structure de liste des IDN

<table>
<tr><th>1. 2.</th><th>3. 4.</th><th colspan="7">← Longueur de la liste →</th></tr>
<tr><td>1C 00</td><td>1C 00</td><td colspan="7"></td></tr>
<tr><td></td><td></td><td>S-0-1000</td><td>S-0-1300. 0,2</td><td>S-0-1300. 0,4</td><td>S-0-1502 0,1</td><td>S-0-1502 0,2</td><td>S-0-1502 1,1</td><td>S-0-1502 1,2</td></tr>
<tr><td></td><td></td><td>Elément de liste #0</td><td>Elément de liste #1</td><td>Elément de liste #2</td><td>Elément de liste #3</td><td>Elément de liste #4</td><td>Elément de liste #5</td><td>Elément de liste #6</td></tr>
<tr><td></td><td colspan="8">Les octets 3 et 4 indiquent la longueur maximale des données d'exploitation présentes dans l'esclave; exemple de longueur = 28 octets (0x001C)</td></tr>
<tr><td colspan="9">Les octets 1 et 2 indiquent la longueur actuelle des données d'exploitation programmées; exemple de longueur = 28 octets (0x001C)</td></tr>
</table>

A.1.9 Structure de l'état des données

Le contenu de l'état des données doit être associé au paramètre entier. “L'état des données” doit comporter des conditions qui varient dynamiquement. Lors de l'ouverture de la voie de service par l'intermédiaire d'un IDN, l'état des données en cours doit être automatiquement transféré au maître. Cela permet à l'unité de commande de répondre à des acquittements de la commande de procédure pendant la transmission d’une commande de procédure. L'état des données (acquittement de la commande de procédure) doit être réinitialisé par l'appareil au cours de chaque nouvelle initialisation.

Les bits 3-0 ne doivent être présents que pour les commandes de procédure (acquittement de la commande de procédure).

Des modifications de l'acquittement de la commande de procédure par:

- bit 3-0: commande de procédure exécutée correctement (0111-->0011 = acquittement positif), ou
- bit 3-0: exécution de la commande de procédure impossible (0111-->1111 = acquittement négatif)

doivent aboutir au réglage du bit de changement de la commande de procédure dans l'état d'appareil.

Le bit 8 doit être réglé par l'appareil si le paramètre est reconnu comme invalide, comme c'est par exemple le cas lorsque la mémoire de données est vérifiée pour une perte de données et une erreur de somme de contrôle est définie.

La structure de l'état des données est présentée dans le Tableau A.6.

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Tableau A.6 – Structure de l'état des données

Bits	Valeur	Signification
15-9	—	(réservé)
8	—	Validité des données d'exploitation
	0	Données d'exploitation valides
	1	Données d'exploitation invalides
7-4	—	(réservé)
3-0	—	Acquittement de la commande de procédure
	0000	Commande de procédure non activée
	0001	Commande de procédure réglée et exécution interrompue
	0011	Commande de procédure exécutée correctement (acquittement positif), le bit de changement de la commande de procédure dans l'état d'appareil est réglé sur 1
	0111	Commande de procédure non encore exécutée (traitement)
	1111	Erreur, exécution de la commande de procédure impossible (acquittement négatif), le bit de changement de la commande de procédure dans l'état d'appareil est réglé sur 1
		Tous les autres codages sont réservés

A.2 Numéros d'identification par ordres numériques

Le Tableau A.7 énumère les IDN de communication, que les appareils de ce type doivent par ailleurs prendre en charge. Leur description détaillée est donnée à l'Article A.3.

Le contenu des données spécifiques à l'application est spécifié dans d'autres normes correspondantes, par exemple, CEI 61800-7-20x.

Tableau A.7 – Liste des IDN de communication appropriés

Numéro d'IDN	Nom de l'IDN
S-0-0014	Etat de l’interface
S-0-0021	liste des IDN de données d'exploitation invalides pour CP2
S-0-0022	liste des IDN de données d'exploitation invalides pour CP3
S-0-0026	Affectation des IDN de conteneur de mots RTB du producteur
S-0-0027	Affectation des IDN de conteneur de mots RTB du consommateur
S-0-0127	Contrôle de transition CP3
S-0-0128	Contrôle de transition CP4
S-0-0144	Conteneur de mots RTB du producteur
S-0-0145	Conteneur de mots RTB du consommateur
S-0-0187	Liste des IDN de données configurables en tant que producteur
S-0-0188	Liste des IDN de données configurables en tant que consommateur
S-0-0328	Affectation de bits de conteneur de mots RTB du producteur
S-0-0329	Affectation de bits de conteneur de mots RTB du consommateur
S-0-0360	conteneur A1 de données MDT
S-0-0361	Conteneur B1 de données MDT
S-0-0362	index de liste de conteneurs A de données MDT
S-0-0363	index de liste de conteneurs B de données MDT
S-0-0364	Conteneur A1 de données AT

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Numéro d'IDN	Nom de l'IDN
S-0-0365	Conteneur B1 de données AT
S-0-0366	index de liste de conteneurs A de données AT
S-0-0367	index de liste de conteneurs B de données AT
S-0-0368	Pointeur de conteneur A de données
S-0-0369	Pointeur de conteneur B de données
S-0-0370	Liste de configuration de conteneurs A&B de données MDT
S-0-0371	Liste de configuration de conteneurs A&B de données AT
S-0-0394	Liste des IDN
S-0-0396	Nombre d'éléments de liste
S-0-0397	Liste de segments
S-0-0398	liste des IDN de bits en temps réel/d'état configurables
S-0-0399	liste des IDN de bits en temps réel/de commande configurables
S-0-0444	liste des IDN de données configurables dans le conteneur de données AT
S-0-0445	liste des IDN de données configurables dans le conteneur de données MDT
S-0-0450	Conteneur A2 de données MDT
S-0-0451	Conteneur A3 de données MDT
S-0-0452	Conteneur A4 de données MDT
S-0-0453	Conteneur A5 de données MDT
S-0-0454	Conteneur A6 de données MDT
S-0-0455	Conteneur A7 de données MDT
S-0-0456	Conteneur A8 de données MDT
S-0-0457	Conteneur A9 de données MDT
S-0-0458	conteneur A10 de données MDT0
S-0-0459	Conteneur B2 de données MDT
S-0-0480	Conteneur A2 de données AT
S-0-0481	Conteneur A3 de données AT
S-0-0482	Conteneur A4 de données AT
S-0-0483	Conteneur A5 de données AT
S-0-0484	Conteneur A6 de données AT
S-0-0485	Conteneur A7 de données AT
S-0-0486	Conteneur A8 de données AT
S-0-0487	Conteneur A9 de données AT
S-0-0488	Conteneur A10 de données AT
S-0-0489	Conteneur B2 de données AT
S-0-0490	Liste de configuration de conteneurs A2 de données MDT
S-0-0491	Liste de configuration de conteneurs A3 de données MDT
S-0-0492	Liste de configuration de conteneurs A4 de données MDT
S-0-0493	Liste de configuration de conteneurs A5 de données MDT
S-0-0494	Liste de configuration de conteneurs A6 de données MDT
S-0-0495	Liste de configuration de conteneurs A7 de données MDT
S-0-0496	Liste de configuration de conteneurs A8 de données MDT
S-0-0497	Liste de configuration de conteneurs A9 de données MDT
S-0-0498	Liste de configuration de conteneurs A10 de données MDT

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Numéro d'IDN	Nom de l'IDN
S-0-0500	Liste de configuration de conteneurs A2 de données AT
S-0-0501	Liste de configuration de conteneurs A3 de données AT
S-0-0502	Liste de configuration de conteneurs A4 de données AT
S-0-0503	Liste de configuration de conteneurs A5 de données AT
S-0-0504	Liste de configuration de conteneurs A6 de données AT
S-0-0505	Liste de configuration de conteneurs A7 de données AT
S-0-0506	Liste de configuration de conteneurs A8 de données AT
S-0-0507	Liste de configuration de conteneurs A9 de données AT
S-0-0508	Liste de configuration de conteneurs A10 de données AT
S-0-1000.0.1	Classes SCP actives
S-0-1000	Type & Version SCP
S-0-1002	Durée du cycle de communication (tScyc)
S-0-1003	Pertes MST admises en CP3/CP4
S-0-1005	Temps de traitement de contrôle par retour minimal (t5)
S-0-1006	Temps de début de transmission d'AT (t1)
S-0-1007	Temps de synchronisation (Tsync)
S-0-1008	Temps de validation de la valeur de commande (t3)
S-0-1009	Décalage de la commande d'appareil (C-DEV) dans le télégramme MDT
S-0-1010	Longueurs des télégrammes MDT
S-0-1011	Décalage de l'état d'appareil (S-DEV) dans le télégramme AT
S-0-1012	Longueurs des télégrammes AT
S-0-1013	Décalage SVC dans le télégramme MDT
S-0-1014	Décalage SVC dans le télégramme AT
S-0-1015	Retard de l'anneau
S-0-1016	Retard de l'esclave (P&S)
S-0-1017	Temps de transmission du canal UC
S-0-1019	Adresse MAC
S-0-1020.0.1	Adresse IP actuelle
S-0-1020	Adresse IP
S-0-1021.0.1	Masque de sous-réseau actuel
S-0-1021	Masque de sous-réseau
S-0-1022.0.1	Adresse de passerelle actuelle
S-0-1022	Adresse de passerelle
S-0-1023	instabilité SYNC
S-0-1024	Commande de procédure de mesure de retard SYNC
S-0-1026	Version du matériel de communication
S-0-1027.0.1	MTU demandée
S-0-1027.0.2	MTU effective
S-0-1028	Compteur d'erreurs MST-P&S
S-0-1031	Port 1 & Port 2 d'attribution de broches d'essai
S-0-1035	Compteur d'erreurs Port 1 & Port 2
S-0-1040	Adresse de sous-appareil
S-0-1041	Temps de validation de la valeur de commande AT (t9)

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Numéro d'IDN	Nom de l'IDN
S-0-1044	Commande d'appareil (C-DEV)
S-0-1045	Etat d'appareil (S-DEV)
S-0-1046	Liste des adresses de sous-appareil dans l'appareil
S-0-1047	Temps d'activation maximal du consommateur (t11)
S-0-1048	Activer les réglages de réseau
S-0-1050.x.1	Configuration de connexion
S-0-1050.x.2	Numéro de connexion
S-0-1050.x.3	Attribution de télégrammes
S-0-1050.x.4	Longueur maximale de connexion
S-0-1050.x.5	Longueur actuelle de connexion
S-0-1050.x.6	Liste de configuration
S-0-1050.x.7	Capacité de connexion attribuée
S-0-1050.x.8	Commande de connexion (C-CON)
S-0-1050.x.10	Durée du cycle du producteur
S-0-1050.x.11	Pertes de données admises
S-0-1050.x.12	Pertes de données des compteurs d'erreurs
S-0-1050.x.20	Affectation des IDN de bits en temps réel
S-0-1050.x.21	Affectation de bits en temps réel
S-0-1051	Schéma illustratif des configurations de connexion
S-0-1060.x.01	Configuration par défaut
S-0-1060.x.02	Masque de configuration
S-0-1060.x.03	Grandeur maximale de cette capacité de connexion
S-0-1060.x.04	Longueur maximale de connexion de la capacité de connexion
S-0-1060.x.06	IDN configurables de la capacité de connexion
S-0-1060.x.07	Temps de traitement maximal
S-0-1060.x.10	Durée minimale du cycle du producteur
S-0-1061	Compteur TSref maximum
S-0-1080.x.02	Conteneur de listes RTB du producteur
S-0-1080.x.03	Affectation des IDN de conteneur de listes RTB du producteur
S-0-1080.x.04	Affectation de bits de conteneur de listes RTB du producteur
S-0-1081.x.02	Conteneur de listes RTB du consommateur
S-0-1081.x.03	Affectation des IDN de conteneur de listes RTB du consommateur
S-0-1081.x.04	Affectation de bits de conteneur de listes RTB du consommateur
S-0-1099.0.01	Contrôle des IDN d'essai à des fins de conformité SCP
S-0-1099.0.02	Conteneur des IDN d'essai à des fins de conformité SCP
S-0-1100.0.01	Fragments SMP transmis par le compteur de diagnostic
S-0-1100.0.02	Fragments SMP reçus par le compteur de diagnostic
S-0-1100.0.03	Fragments SMP rejetés par le compteur de diagnostic
S-0-1101.x.01	Données de conteneur SMP
S-0-1101.x.02	Liste des identifiants de session
S-0-1101.x.03	Liste des priorités de session
S-0-1150.x.01	Commande OVS (C-OVS)
S-0-1150.x.02	Etat OVS (S-OVS)

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Numéro d'IDN	Nom de l'IDN
S-0-1150.x.03	Conteneur OVS
S-0-1150.x.04	Durée d'échantillonnage
S-0-1150.x.05	Déphasage
S-0-1150.x.06	Liste de configuration OVS – IDN
S-0-1150.x.07	Liste de configuration OVS – Décalage
S-0-1150.x.08	Liste de configuration OVS – Longueur
S-0-1150.x.09	Capacité de suréchantillonnage attribuée
S-0-1150.x.10	Nombre d'échantillons
S-0-1151.x.01	Nombre maximal d'échantillons
S-0-1151.x.02	Résolution interne
S-0-1151.x.03	Grandeur maximale de cette capacité de suréchantillonnage
S-0-1151.x.04	Durée d'échantillonnage minimale
S-0-1151.x.06	IDN configurables de capacité OVS
S-0-1151.x.07	IDN configurables de capacité OVS – Décalage
S-0-1151.x.08	IDN configurables de capacité OVS – Longueur
S-0-1152	Nombre de domaines OVS
NOTE Tous les autres numéros d'IDN sont réservés.	

A.3 Spécification détaillée des IDN de communication

A.3.1 IDN S-0-0014 Etat d'interface

A.3.1.1 Attributs

Le Tableau A.8 présente les attributs potentiels pour cet IDN.

Tableau A.8 – Attributs de l'IDN S-0-0014

Attribut	Valeur
Nom	Etat de l'interface
Version	—
Longueur	2
Format d'affichage	Binaire
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.1.2 Description

Si une erreur est définie dans l'état d'interface, l'erreur C1D est alors définie dans l'état d'appareil (S-0-1045 Etat d'appareil (S-DEV)).

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Le réglage des bits 2-0 ne désigne pas une erreur. En l'absence d'erreurs de communication, la phase de communication actuelle est contenue dans l'état d'interface. En cas d'erreur avérée, cette dernière et la CP actuelle sont archivées simultanément.

Les bits d'erreur de l'état d'interface sont remis à '0' par le sous-appareil uniquement en l'absence d'erreurs d'état d'interface, et après réception de la commande de procédure S-0-0099 Diagnostic de classe 1 de réinitialisation par le sous-appareil via la voie de service.

Le Tableau A.9 présente la structure de l'état d'interface.

Tableau A.9 – Structure de l'état d'interface

Numéro de bit	Valeur	Signification
15	0 = pas d'erreur 1 = erreur	Erreur spécifique au constructeur
14		Topologie et communication
13		Commutation de phase dans des conditions invalides
12		Temporisation CPS-MST lors de la commutation de phase
11		(réservé)
10		(réservé)
9		(réservé)
8		(réservé)
7		(réservé)
6		(réservé)
5		phase invalide (phase > 4)
4		(réservé)
3		Défaillance MST (S-0-1003 Pertes MST admises en phases CP3 & CP4)
2-0	000 … 100	CP0 … CP4
	101 … 110	(réservé)
	111	Mode NRT

A.3.2 IDN S-0-0021 Liste des IDN de données d'exploitation invalides pour CP2

A.3.2.1 Attributs

Le Tableau A.10 présente les attributs potentiels pour cet IDN.

Tableau A.10 – Attributs de l'IDN S-0-0021

Attribut	Valeur
Nom	liste des IDN de données d'exploitation invalides pour CP2
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1

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Attribut	Valeur
Unité	—

A.3.2.2 Description

Les IDN que l'esclave considère comme invalides lorsqu'il effectue le contrôle de transition CP3, sont archivés dans cette liste des IDN.

- Cas 1: la commande de procédure S-0-0127 est effectuée correctement; la liste des IDN (S-0-0021) ne contient aucun IDN.
- Cas 2: la commande de procédure S-0-0127 génère une erreur; la liste des IDN (S-0-0021) contient tous les IDN des données d'exploitation invalides.

La présence de ce paramètre est nécessaire uniquement si cet esclave a une propension aux erreurs lors de la commutation de phase (S-0-0127).IDN S-0-0022 Liste des IDN de données d'exploitation invalides pour CP3.

A.3.2.3 Attributs

Le Tableau A.11 présente les attributs potentiels pour cet IDN.

Tableau A.11 – Attributs de l'IDN S-0-0022

Attribut	Valeur
Nom	liste des IDN de données d'exploitation invalides pour CP3
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.2.4 Description

Les IDN que l'esclave considère comme invalides lorsqu'il effectue le contrôle de transition CP4, sont archivés dans cette liste des IDN.

- Cas 1: la commande de procédure S-0-0128 est effectuée correctement; la liste des IDN (S-0-0022) ne contient aucun IDN.
- Cas 2: la commande de procédure S-0-0128 génère une erreur; la liste des IDN (S-0-0022) contient tous les IDN des données d'exploitation invalides.

La présence de ce paramètre est nécessaire uniquement si cet esclave a une propension aux erreurs lors de la commutation de phase (S-0-0128).

A.3.3 IDN S-0-0026 Affectation des IDN de conteneur de mots RTB du producteur

A.3.3.1 Attributs

Le Tableau A.12 présente les attributs potentiels pour cet IDN.

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Tableau A.12 – Attributs de l'IDN S-0-00226

Attribut	Valeur
Nom	Affectation des IDN de conteneur de mots RTB du producteur
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.3.2 Description

Les bits internes au conteneur de mots RTB du producteur (S-0-0144) peuvent être définis grâce à la liste de configuration du conteneur de mots RTB du producteur représentée dans cet IDN. La séquence des IDN dans la liste de configuration détermine le programme de numérotation des bits dans le conteneur de mots RTB du producteur. Le premier IDN de la liste de configuration définit le bit 0, le dernier IDN définit le bit 15 du conteneur de mots RTB du producteur. Si l'IDN S-0-0328 n'est pas pris en charge par l'esclave, le bit 0 de tous les IDN configurés est utilisé, S-0-0328 définit alors quel bit est utilisé pour chaque IDN. 16 IDN au maximum peuvent être inclus dans cette liste. Par conséquent, celle-ci doit avoir une longueur fixe de 64 octets.

A.3.4 IDN S-0-0027 Affectation des IDN de conteneur de mots RTB du consommateur

A.3.4.1 Attributs

Le Tableau A.13 présente les attributs potentiels pour cet IDN.

Tableau A.13 – Attributs de l'IDN S-0-0027

Attribut	Valeur
Nom	Affectation des IDN de conteneur de mots RTB du consommateur
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

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A.3.4.2 Description

Les bits internes au conteneur de mots RTB du consommateur (S-0-0145) peuvent être définis grâce à la liste de configuration du conteneur de mots RTB du consommateur représentée dans cet IDN. La séquence des IDN dans la liste de configuration détermine le programme de numérotation des bits dans le conteneur de mots RTB du consommateur. Le premier IDN de la liste de configuration définit le bit 0, le dernier IDN définit le bit 15 du conteneur de mots RTB du consommateur. Si l'IDN S-0-0329 n'est pas pris en charge par l'esclave, le bit 0 de tous les IDN configurés est utilisé, S-0-0329 définit alors quel bit est utilisé pour chaque IDN. 16 IDN au maximum peuvent être inclus dans cette liste. Par conséquent, celle-ci doit avoir une longueur fixe de 64 octets.

A.3.5 IDN S-0-0127 Contrôle de transition CP3

A.3.5.1 Attributs

Le Tableau A.14 présente les attributs potentiels pour cet IDN.

Tableau A.14 – Attributs de l'IDN S-0-0127

Attribut	Valeur
Nom	Contrôle de transition CP3
Version	—
Longueur	2
Format d'affichage	Binaire
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.5.2 Description

Le maître utilise cette commande de procédure pour informer l'esclave de vérifier que tous les paramètres nécessaires ont été transférés pour CP3. Dans le cas contraire, cette commande de procédure génère une erreur (voir S-0-0021). Une fois la commande de procédure exécutée correctement, il est nécessaire que le maître annule cette dernière. Il peut alors activer la phase CP3 dans le télégramme MST.

A.3.6 IDN S-0-0128 Contrôle de transition CP4

A.3.6.1 Attributs

Le Tableau A.15 présente les attributs potentiels pour cet IDN.

Tableau A.15 – Attributs de l'IDN S-0-0128

Attribut	Valeur
Nom	Contrôle de transition CP4
Version	—
Longueur	2
Format d'affichage	Binaire

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Attribut	Valeur
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.6.2 Description

Le maître utilise cette commande de procédure pour informer l'esclave de vérifier que tous les paramètres nécessaires ont été transférés pour CP4. Dans le cas contraire, cette commande de procédure génère une erreur (voir S-0-0022). Une fois la commande de procédure exécutée correctement, il est nécessaire que le maître annule cette dernière. Il peut alors activer la phase CP4 dans le télégramme MST.

A.3.7 IDN S-0-0144 Conteneur de mots RTB du producteur

A.3.7.1 Attributs

Le Tableau A.16 présente les attributs potentiels pour cet IDN.

Tableau A.16 – Attributs de l'IDN S-0-0144

Attribut	Valeur
Nom	Conteneur de mots RTB du producteur
Version	—
Longueur	2
Format d'affichage	Binaire
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.7.2 Description

Les signaux peuvent être transmis en temps réel du producteur au consommateur grâce au conteneur de mots RTB du producteur. A cette fin, le conteneur de mots RTB du producteur doit être intégré dans une ou plusieurs connexions du producteur.

Les bits internes au conteneur de mots RTB du producteur sont définis grâce aux listes de configuration du conteneur de mots RTB du producteur (voir S-0-0026 et S-0-0328).

A.3.8 IDN S-0-0145 Conteneur de mots RTB du consommateur

A.3.8.1 Attributs

Le Tableau A.17 présente les attributs potentiels pour cet IDN.

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Tableau A.17 – Attributs de l'IDN S-0-0027

Attribut	Valeur
Nom	Conteneur de mots RTB du consommateur
Version	—
Longueur	2
Format d'affichage	Binaire
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.8.2 Description

Les signaux peuvent être transmis en temps réel du producteur au consommateur grâce au conteneur de mots RTB du consommateur. A cette fin, le conteneur de mots RTB du consommateur doit être intégré dans une connexion du consommateur.

Les bits internes au conteneur de mots RTB du consommateur sont définis grâce aux listes de configuration du conteneur de mots RTB du consommateur (voir S-0-0027 et S-0-0329).

A.3.9 IDN S-0-0187 Liste des IDN de données configurables en tant que producteur

A.3.9.1 Attributs

Le Tableau A.18 présente les attributs potentiels pour cet IDN.

Tableau A.18 – Attributs de l'IDN S-0-0187

Attribut	Valeur
Nom	Liste des IDN de données configurables en tant que producteur
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.9.2 Description

Cette liste des IDN contient tous les IDN des données d'exploitation du producteur (par exemple: valeurs de retour, entrées) qui peuvent être traitées de manière cyclique dans le télégramme AT par le sous-appareil.

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Si l'IDN S-0-1060 existe, des informations détaillées supplémentaires concernant le paramètre de connexion seront fournies.

A.3.10 IDN S-0-0188 Liste des IDN de données configurables en tant que consommateur

A.3.10.1 Attributs

Le Tableau A.19 présente les attributs potentiels pour cet IDN.

Tableau A.19 – Attributs de l'IDN S-0-0188

Attribut	Valeur
Nom	Liste des IDN de données configurables en tant que consommateur
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.10.2 Description

Cette liste des IDN contient tous les IDN des données d'exploitation (valeurs de commande) qui peuvent être traitées de manière cyclique par le sous-appareil.

Si l'IDN S-0-1060 existe, des informations détaillées supplémentaires concernant le paramètre de connexion seront fournies.

A.3.11 IDN S-0-0328 Affectation de bits de conteneur de mots RTB du producteur

A.3.11.1 Attributs

Le Tableau A.20 présente les attributs potentiels pour cet IDN.

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Tableau A.20 – Attributs de l'IDN S-0-0328

Attribut	Valeur
Nom	Affectation de bits de conteneur de mots RTB du producteur
Version	—
Longueur	2, variable
Format d'affichage	Décimale non signée (numéro de bit)
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.11.2 Description

Les numéros de bit des données d'exploitation sont programmés dans cette liste de configuration, et sont reproduits dans le conteneur de mots RTB du producteur. La séquence des numéros de bit dans la liste de configuration détermine l'ordre numérique dans le conteneur de mots RTB du producteur. Le premier numéro de bit dans la liste de configuration définit le bit 0, le dernier numéro de bit définit le bit 15 du conteneur de mots RTB du producteur. Un numéro de 16 bits au maximum peut être inclus dans cette liste. Par conséquent, celle-ci doit avoir une longueur fixe de 32 octets (voir également S-0-0026).

A.3.12 IDN S-0-0329 Affectation de bits de conteneur de mots RTB du consommateur

A.3.12.1 Attributs

Le Tableau A.21 présente les attributs potentiels pour cet IDN.

Tableau A.21 – Attributs de l'IDN S-0-0329

Attribut	Valeur
Nom	Affectation de bits de conteneur de mots RTB du consommateur
Version	—
Longueur	2, variable
Format d'affichage	Décimale non signée (numéro de bit)
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.12.2 Description

Les numéros de bit des données d'exploitation sont programmés dans cette liste de configuration, et sont reproduits dans le conteneur de mots RTB du consommateur (S-0-0145). La séquence des numéros de bit dans la liste de configuration détermine l'ordre

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numérique dans le conteneur de mots RTB du consommateur. Le premier numéro de bit dans la liste de configuration définit le bit 0, le dernier numéro de bit définit le bit 15 du conteneur de mots RTB du consommateur. Un numéro de 16 bits au maximum peut être inclus dans cette liste. Par conséquent, celle-ci doit avoir une longueur fixe de 32 octets (voir également S-0-0027).

A.3.13 IDN S-0-0360 Conteneur A1 de données MDT

A.3.13.1 Attributs

Le Tableau A.22 présente les attributs potentiels pour cet IDN.

Tableau A.22 – Attributs de l'IDN S-0-0360

Attribut	Valeur
Nom	Conteneur A1 de données MDT
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.13.2 Description

Pour la fonction du conteneur de données standard dans le MDT,

- deux conteneurs de données (longueur de 4 octets, A1 et B1) et
- deux conteneurs de données (longueur de 8 octets, A9 et B2) et

sont définis, et utilisés comme paramètres fictifs dans le MDT. Le maître peut, si nécessaire, modifier le contenu des conteneurs de données de manière dynamique. De plus, le pointeur de conteneurs A de données (S-0-0368) est requis pour les conteneurs A1 et A9 (S-0-0360 et S-0-0457). Le pointeur de conteneurs B de données (S-0-0369) est requis pour les conteneurs B1 et B2 (S-0-0361 et S-0-0459), ainsi qu'une liste de configuration (S-0-0370) pour tous les conteneurs MDT. Lorsque les données d'exploitation configurées ont une longueur de 2 ou 4 octets seulement, elles sont placées dans la partie inférieure du conteneur de données MDT. La partie supérieure n'est pas utilisée.

Pour la configuration des données d'exploitation dans le conteneur de données, l'esclave peut choisir entre une exigence minimale et une exigence maximale.

- Bloc de données requis minimal (accès via la voie de service):
  – Les données d'exploitation configurées sont représentées dans le conteneur de données au format hexadécimal, sans les unités.
    - Attribut: Le type de données et le format d'affichage sont définis au format hexadécimal (bits 22-20 = 011)
    - Unités: Inexistantes
- Bloc de données requis maximal (accès via la voie de service):

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– Les données d'exploitation configurées sont représentées dans le conteneur de données, mais non avec le bloc de données du conteneur de données proprement dit, mais plutôt avec le bloc des données d'exploitation configurées. Dans ce cas, les données d'exploitation sont affichées avec l'IDN du conteneur de données, exactement de la même manière qu'elles le seraient avec leurs propres IDN.

NOTE Les conteneurs A1 (S-0-0360) et A9 (S-0-0457) de données MDT sont utilisés également dans la fonction de conteneur de données étendu.

A.3.14 IDN S-0-0361 Conteneur B1 de données MDT

A.3.14.1 Attributs

Le Tableau A.23 présente les attributs potentiels pour cet IDN.

Tableau A.23 – Attributs de l'IDN S-0-0361

Attribut	Valeur
Nom	Conteneur B1 de données MDT
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.14.2 Description

Pour la fonction du conteneur de données standard dans le MDT,

- deux conteneurs de données (longueur de 4 octets, A1 et B1) et
- deux conteneurs de données (longueur de 8 octets, A9 et B2)

sont définis, et utilisés comme paramètres fictifs dans le MDT. Le maître peut, si nécessaire, modifier le contenu des conteneurs de données de manière dynamique. De plus, le pointeur de conteneurs A de données (S-0-0368) est requis pour les conteneurs A1 et A9 (S-0-0360 et S-0-0457). Le pointeur de conteneurs B de données (S-0-0369) est requis pour les conteneurs B1 et B2 (S-0-0361 et S-0-0459), ainsi qu'une liste de configuration (S-0-0370) pour tous les conteneurs MDT. Lorsque les données d'exploitation configurées ont une longueur de 2 ou 4 octets seulement, elles sont placées dans la partie inférieure du conteneur de données MDT. La partie supérieure n'est pas utilisée.

Pour la configuration des données d'exploitation dans le conteneur de données, l'esclave peut choisir entre une exigence minimale et une exigence maximale.

- Bloc de données requis minimal (accès via la voie de service):
  – Les données d'exploitation configurées sont représentées dans le conteneur de données au format hexadécimal, sans les unités.
    - Attribut: Le type de données et le format d'affichage sont définis au format hexadécimal (bits 22-20 = 011)
    - Unités: Inexistantes

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- Bloc de données requis maximal (accès via la voie de service):
  – Les données d'exploitation configurées sont représentées dans le conteneur de données, mais non avec le bloc de données du conteneur de données proprement dit, mais plutôt avec le bloc des données d'exploitation configurées. Dans ce cas, les données d'exploitation sont affichées avec l'IDN du conteneur de données, exactement de la même manière qu'elles le seraient avec leurs propres IDN.

NOTE Les conteneurs A1 (S-0-0360) et A9 (S-0-0457) de données MDT sont utilisés également dans la fonction de conteneur de données étendu.

A.3.15 IDN S-0-0362 Index de liste de conteneurs A de données MDT

A.3.15.1 Attributs

Le tableau suivant présente les attributs potentiels pour cet IDN.

Tableau A.24 – Attributs de l'IDN S-0-0362

Attribut	Valeur
Nom	Index de liste de conteneurs A de données MDT
Version	—
Longueur	2
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.15.2 Description

Si, dans le conteneur de données MDT, un IDN de longueur variable (paramètre de liste) est configuré,

- l'élément de liste correspondant de ce paramètre de liste est adressé via l'index de liste,
- le maître saisit l'élément de liste adressé dans le conteneur de données MDT.

L'index de liste du conteneur de données MDT consiste en une adresse de 16 bits. Le conteneur de données MDT peut être défini comme non valide par le maître, via l'index de liste 65535.

L'index de liste du conteneur de données MDT peut être configuré dans les données cycliques du MDT. De ce fait, une commutation des éléments de liste dans le conteneur de données MDT pendant le cycle de communication suivant est possible.

Lorsque l'index de liste est extérieur au paramètre de liste, les données internes aux conteneurs de données MDT correspondants sont ignorées par l'esclave. Dans ce cas, l'esclave doit régler l'index de liste (acquittement) sur la valeur 65535 et éventuellement le pointeur du conteneur de données MDT sur la valeur 255.

L'index de liste du conteneur de données MDT (voir Tableau A.25 peut être également configuré dans les données cycliques des télégrammes AT. Un acquittement du conteneur de

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données MDT est ainsi possible. L'esclave lit l'index de liste du conteneur de données MDT à partir du télégramme MDT et l'acquitte dans le télégramme AT.

Tableau A.25 – Index de liste du conteneur A de données MDT

Numéro de bit	Valeur	Description
15-0	Structure de l'index de liste du conteneur A de données MDT:	
	0-65534	index du paramètre de liste configuré
	65535	conteneur A de données MDT non valide (erreur)

A.3.16 IDN S-0-0363 Index de liste de conteneurs B de données MDT

A.3.16.1 Attributs

Le Tableau A.26 présente les attributs potentiels pour cet IDN.

Tableau A.26 – Attributs de l'IDN S-0-0363

Attribut	Valeur
Nom	index de liste de conteneurs B de données MDT
Version	—
Longueur	2
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.16.2 Description

Si, dans le conteneur de données MDT, un IDN de longueur variable (paramètre de liste) est configuré,

- l'élément de liste correspondant de ce paramètre de liste est adressé via l'index de liste,
- le maître saisit l'élément de liste adressé dans le conteneur de données MDT.

L'index de liste du conteneur de données MDT consiste en une adresse de 16 bits. Le conteneur de données MDT peut être défini comme non valide par le maître, via l'index de liste 65535.

L'index de liste du conteneur de données MDT peut être configuré dans les données cycliques du MDT. De ce fait, une commutation des éléments de liste dans le conteneur de données MDT pendant le cycle de communication suivant est possible.

Lorsque l'index de liste est extérieur au paramètre de liste, les données internes aux conteneurs de données MDT correspondants sont ignorées par l'esclave. Dans ce cas, l'esclave doit régler l'index de liste (acquittement) sur la valeur 65535 et éventuellement le pointeur du conteneur de données MDT sur la valeur 255.

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L'index de liste du conteneur de données MDT (voir Tableau A.27) peut être également configuré dans les données cycliques des télégrammes AT. Un acquittement du conteneur de données MDT est ainsi possible. L'esclave lit l'index de liste du conteneur de données MDT à partir du télégramme MDT et l'acquitte dans le télégramme AT.

Tableau A.27 – Index de liste du conteneur B de données MDT

Numéro de bit	Valeur	Description
15-0	Structure de l'index de liste du conteneur B de données MDT:	
	0-65534	index du paramètre de liste configuré
	65535	conteneur B de données MDT non valide (erreur)

A.3.17 IDN S-0-0364 Conteneur A1 de données AT

A.3.17.1 Attributs

Le Tableau A.28 présente les attributs potentiels pour cet IDN.

Tableau A.28 – Attributs de l'IDN S-0-0364

Attribut	Valeur
Nom	Conteneur A1 de données AT
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.17.2 Description

Pour la fonction du conteneur de données standard dans l'AT,

- deux conteneurs de données (longueur de 4 octets, A1 et B1) et
- deux conteneurs de données (longueur de 8 octets, A9 et B2)

sont définis, et utilisés comme paramètres fictifs dans l'AT. Le maître peut, si nécessaire, modifier le contenu des conteneurs de données de manière dynamique. De plus, le pointeur de conteneurs A de données (S-0-0368) est requis pour les conteneurs A1 et A9 (S-0-0364 et S-0-0487). Le pointeur de conteneurs B de données (S-0-0369) est requis pour les conteneurs B1 et B2 (S-0-0365 et S-0-0489), ainsi qu'une liste de configuration (S-0-0371) pour tous les conteneurs AT. Lorsque les données d'exploitation configurées ont une longueur de 2 ou 4 octets seulement, elles sont placées dans la partie inférieure du conteneur de données AT. La partie supérieure n'est pas utilisée.

Pour la configuration des données d'exploitation dans le conteneur de données, l'esclave peut choisir entre une exigence minimale et une exigence maximale.

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- Bloc de données requis minimal (accès via la voie de service):
  – Les données d'exploitation configurées sont représentées dans le conteneur de données au format hexadécimal, sans les unités.
    - Attribut: Le type de données et le format d'affichage sont définis au format hexadécimal (bits 22-20 = 011)
    - Unités: Inexistantes
- Bloc de données requis maximal (accès via la voie de service):
  – Les données d'exploitation configurées sont représentées dans le conteneur de données, mais non avec le bloc de données du conteneur de données proprement dit, mais plutôt avec le bloc des données d'exploitation configurées. Dans ce cas, les données d'exploitation sont affichées avec l'IDN du conteneur de données, exactement de la même manière qu'elles le seraient avec leurs propres IDN.

NOTE Les conteneurs A1 (S-0-0364) et A9 (S-0-0487) de données AT sont utilisés également dans la fonction de conteneur de données étendu.

A.3.18 IDN S-0-0365 Conteneur B1 de données AT

A.3.18.1 Attributs

Le Tableau A.29 présente les attributs potentiels pour cet IDN.

Tableau A.29 – Attributs de l'IDN S-0-0365

Attribut	Valeur
Nom	Conteneur B1 de données AT
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.18.2 Description

Pour la fonction du conteneur de données standard dans l'AT,

- deux conteneurs de données (longueur de 4 octets, A1 et B1) et
- deux conteneurs de données (longueur de 8 octets, A9 et B2) et

sont définis, et utilisés comme paramètres fictifs dans l'AT. Le maître peut, si nécessaire, modifier le contenu des conteneurs de données de manière dynamique. De plus, le pointeur de conteneurs A de données (S-0-0368) est requis pour les conteneurs A1 et A9 (S-0-0364 et S-0-0487). Le pointeur de conteneurs B de données (S-0-0369) est requis pour les conteneurs B1 et B2 (S-0-0365 et S-0-0489), ainsi qu'une liste de configuration (S-0-0371) pour tous les conteneurs AT. Lorsque les données d'exploitation configurées ont une longueur de 2 ou 4 octets seulement, elles sont placées dans la partie inférieure du conteneur de données AT. La partie supérieure n'est pas utilisée.

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Pour la configuration des données d'exploitation dans le conteneur de données, l'esclave peut choisir entre une exigence minimale et une exigence maximale.

- Bloc de données requis minimal (accès via la voie de service):
  - Les données d'exploitation configurées sont représentées dans le conteneur de données au format hexadécimal, sans les unités.
    - Attribut: Le type de données et le format d'affichage sont définis au format hexadécimal (bits 22-20 = 011)
    - Unités: Inexistantes
- Bloc de données requis maximal (accès via la voie de service):
  - Les données d'exploitation configurées sont représentées dans le conteneur de données, mais non avec le bloc de données du conteneur de données proprement dit, mais plutôt avec le bloc des données d'exploitation configurées. Dans ce cas, les données d'exploitation sont affichées avec l'IDN du conteneur de données, exactement de la même manière qu'elles le seraient avec leurs propres IDN.

NOTE Les conteneurs A1 (S-0-0364) et A9 (S-0-0487) de données AT sont utilisés également dans la fonction de conteneur de données étendu.

A.3.19 IDN S-0-0366 Index de liste de conteneurs A de données AT

A.3.19.1 Attributs

Le Tableau A.30 présente les attributs potentiels pour cet IDN.

Tableau A.30 – Attributs de l'IDN S-0-0366

Attribut	Valeur
Nom	Index de liste de conteneurs A de données AT
Version	—
Longueur	2
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.19.2 Description

Si, dans le conteneur de données AT, un IDN de longueur variable (paramètre de liste) est configuré,

- l'élément de liste correspondant de ce paramètre de liste est adressé via l'index de liste,
- l'esclave saisit l'élément de liste adressé dans le conteneur de données AT.

L'index de liste du conteneur de données AT consiste en une adresse de 16 bits. Le conteneur de données AT peut être défini comme non valide par l'esclave, via l'index de liste 65535.

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L'index de liste du conteneur de données AT peut être configuré dans les données cycliques du MDT. De ce fait, une commutation des éléments de liste dans le conteneur de données AT pendant le cycle de communication suivant est possible.

Lorsque l'index de liste est extérieur au paramètre de liste, les données internes aux conteneurs de données AT correspondants sont ignorées par le maître. Dans ce cas, l'esclave doit régler l'index de liste (acquittement) sur la valeur 65535 et éventuellement le pointeur du conteneur de données AT sur la valeur 255.

L'index de liste du conteneur de données AT (Tableau A.31) peut être également configuré dans les données cycliques des télégrammes AT. Un acquittement du conteneur de données AT est ainsi possible. L'esclave lit l'index de liste du conteneur de données AT à partir du télégramme MDT et l'acquitte dans le télégramme AT.

Tableau A.31 – Index de liste du conteneur A de données AT

Numéro de bit	Valeur	Description
15-0	Structure de l'index de liste de conteneurs A de données AT:	
	0-65534	index du paramètre de liste configuré
	65535	Conteneur A de données AT non valide (erreur)

A.3.20 IDN S-0-0367 Index de liste de conteneurs B de données AT

A.3.20.1 Attributs

Le Tableau A.32 présente les attributs potentiels pour cet IDN.

Tableau A.32 – Attributs de l'IDN S-0-0367

Attribut	Valeur
Nom	index de liste de conteneurs B de données AT
Version	—
Longueur	2
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.20.2 Description

Si, dans le conteneur de données AT, un IDN de longueur variable (paramètre de liste) est configuré,

- l'élément de liste correspondant de ce paramètre de liste est adressé via l'index de liste.
- L'esclave saisit l'élément de liste adressé dans le conteneur de données AT.

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L'index de liste du conteneur de données AT consiste en une adresse de 16 bits. Le conteneur de données AT peut être défini comme non valide par l'esclave, via l'index de liste 65535.

L'index de liste du conteneur de données AT peut être configuré dans les données cycliques du MDT. De ce fait, une commutation des éléments de liste dans le conteneur de données AT pendant le cycle de communication suivant est possible.

Lorsque l'index de liste est extérieur au paramètre de liste, les données internes aux conteneurs de données AT correspondants sont ignorées par le maître. Dans ce cas, l'esclave doit régler l'index de liste (acquittement) sur la valeur 65535 et éventuellement le pointeur du conteneur de données AT sur la valeur 255.

L'index de liste du conteneur de données AT (Tableau A.33) peut être également configuré dans les données cycliques des télégrammes AT. Un acquittement du conteneur de données AT est ainsi possible. L'esclave lit l'index de liste du conteneur de données AT à partir du télégramme MDT et l'acquitte dans le télégramme AT.

Tableau A.33 – Index de liste du conteneur B de données AT

Numéro de bit	Valeur	Description
15-0	Structure de l'index de liste de conteneurs B de données AT:	
	0-65534	index du paramètre de liste configuré
	65535	conteneur B de données AT non valide (erreur)

A.3.21 IDN S-0-0368 Pointeur de conteneur A de données

A.3.21.1 Attributs

Le Tableau A.34 présente les attributs potentiels pour cet IDN.

Tableau A.34 – Attributs de l'IDN S-0-0368

Attribut	Valeur
Nom	Pointeur de conteneur A de données
Version	—
Longueur	2
Format d'affichage	hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.21.2 Description

Les pointeurs de conteneurs de données comportent un pointeur à 8 bits, qui définit les données d'exploitation qu'il convient d'intégrer au conteneur de données MDT et AT. Le

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pointeur du conteneur de données représente le décalage dans la liste de configuration des données d'exploitation correspondante.

- pour le conteneur de données standard S-0-0370 et S-0-0371,
- également pour le conteneur de données étendu S-0-0490 à S-0-0498 et S-0-0500 à S-0-0508.

Dans ce cas précis, un IDN est adressé dans la liste de configuration pour le conteneur de données MDT ou AT.

Le maître saisit les données d'exploitation adressées dans le conteneur de données MDT. L'esclave saisit les données d'exploitation adressées dans le conteneur de données AT.

Les pointeurs de "conteneurs A et B de données" (S-0-0368, S-0-0369) peuvent être configurés dans les données cycliques du MDT. De ce fait, une commutation des données d'exploitation dans les conteneurs de données pendant le cycle de communication suivant est possible.

Les pointeurs de "conteneurs A et B de données" (S-0-0368, S-0-0369) peuvent également être configurés dans les données cycliques de l'AT. Dans ce cas, l'adressage (acquittement) selon le contenu du conteneur de données est transmis. L'esclave génère l'acquittement par reproduction du pointeur de MDT dans le pointeur d'AT.

Si le pointeur du conteneur de données (Tableau A.35) est extérieur à la liste de configuration pour le conteneur de données MDT ou AT, ou si la longueur des données est supérieure à celle du conteneur, le contenu de ce dernier n'est pas valide. L'esclave règle le pointeur (acquittement) du télégramme AT sur 255. Les données internes au conteneur de données MDT ou AT sont ignorées par l'esclave ou le maître.

Tableau A.35 – Structure du pointeur de conteneur A de données

Numéro de bit	Valeur	Description
15-8	—	Adresse pour le conteneur de données AT
	0-254	Adresse pour le conteneur A de données AT
	255	Conteneur A de données AT non valide (erreur)
7-0	—	Adresse pour le conteneur de données MDT
	0-254	Adresse pour le conteneur A de données MDT
	255	Conteneur de données MDT non valide (erreur)

A.3.22 IDN S-0-0369 Pointeur de conteneur B de données

A.3.22.1 Attributs

Le Tableau A.36 présente les attributs potentiels pour cet IDN.

Tableau A.36 – Attributs de l'IDN S-0-0369

Attribut	Valeur
Nom	Pointeur de conteneur B de données
Version	—
Longueur	2
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—

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Attribut	Valeur
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.22.2 Description

Les pointeurs de conteneurs de données comportent un pointeur à 8 bits, qui définit les données d'exploitation qu'il convient d'intégrer au conteneur de données MDT et AT. Le pointeur du conteneur de données représente le décalage dans la liste de configuration des données d'exploitation correspondante.

- pour le conteneur de données standard S-0-0370 et S-0-0371,
- également pour le conteneur de données étendu S-0-0490 à S-0-0498 et S-0-0500 à S-0-0508.

Dans ce cas précis, un IDN est adressé dans la liste de configuration pour le conteneur de données MDT ou AT.

Le maître saisit les données d'exploitation adressées dans le conteneur de données MDT. L'esclave saisit les données d'exploitation adressées dans le conteneur de données AT.

Les pointeurs de "conteneurs A et B de données" (S-0-0368, S-0-0369) peuvent être configurés dans les données cycliques du MDT. De ce fait, une commutation des données d'exploitation dans les conteneurs de données pendant le cycle de communication suivant est possible.

Les pointeurs de "conteneurs A et B de données" (S-0-0368, S-0-0369) peuvent également être configurés dans les données cycliques de l'AT. Dans ce cas, l'adressage (acquittement) selon le contenu du conteneur de données est transmis. L'esclave génère l'acquittement par reproduction du pointeur de MDT dans le pointeur d'AT.

Si le pointeur du conteneur de données (Tableau A.37) est extérieur à la liste de configuration pour le conteneur de données MDT ou AT, ou si la longueur des données est supérieure à celle du conteneur, le contenu de ce dernier n'est pas valide. L'esclave règle le pointeur (acquittement) du télégramme AT sur 255. Les données internes au conteneur de données MDT ou AT sont ignorées par l'esclave ou le maître.

Tableau A.37 – Structure du pointeur de conteneur B de données

Numéro de bit	Valeur	Description
15-8	—	Adresse pour le conteneur de données AT
	0-254	Adresse pour le conteneur B de données AT
	255	Conteneur A de données AT non valide (erreur)
7-0	—	Adresse pour le conteneur de données MDT
	0-254	Adresse pour le conteneur B de données MDT
	255	Conteneur de données MDT non valide (erreur)

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A.3.23 IDN S-0-0370 Liste de configuration de conteneurs A/B de données MDT

A.3.23.1 Attributs

Le Tableau A.38 présente les attributs potentiels pour cet IDN.

Tableau A.38 – Attributs de l'IDN S-0-0370

Attribut	Valeur
Nom	Liste de configuration de conteneurs A/B de données MDT
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.23.2 Description

Le maître saisit, dans la liste de configuration des conteneurs de données MDT, les numéros IDN relatifs aux données d'exploitation à envoyer via les conteneurs de données MDT correspondants (A et B du conteneur de données standard, et A1 à A10 du conteneur de données étendu), si nécessaire entre le maître et l'esclave.

Les IDN de cette liste des IDN peuvent provenir de S-0-0445 Liste des IDN de données configurables dans le conteneur de données MDT ou de S-0-0188 Liste des IDN de données configurables en tant que consommateur, en l'absence de S-0-0445.

A.3.24 IDN S-0-0371 Liste de configuration de conteneurs A/B de données AT

A.3.24.1 Attributs

Le Tableau A.39 présente les attributs potentiels pour cet IDN.

Tableau A.39 – Attributs de l'IDN S-0-0371

Attribut	Valeur
Nom	Liste de configuration de conteneurs A/B de données AT
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1

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Attribut	Valeur
Unité	—

A.3.24.2 Description

Le maître saisit, dans la liste de configuration des conteneurs de données AT, les numéros IDN relatifs aux données d'exploitation à envoyer via les conteneurs de données AT correspondants (A et B du conteneur de données standard, et A1 à A10 du conteneur de données étendu), si nécessaire entre l'esclave et le maître.

Les IDN de cette liste des IDN peuvent provenir de S-0-0444 ou de S-0-0187, en l'absence du premier IDN.

A.3.25 IDN S-0-0394 Liste des IDN

A.3.25.1 Attributs

Le Tableau A.40 présente les attributs potentiels pour cet IDN.

Tableau A.40 – Attributs de l'IDN S-0-0394

Attribut	Valeur
Nom	Liste des IDN
Version	—
Longueur	4
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.25.2 Description

Le numéro d'identification d'un paramètre de longueur variable est archivé dans ce paramètre. Ce paramètre doit être interprété uniquement si l'accès au segment de liste (S-0-0397) est possible.

A.3.26 IDN S-0-0395 Index de liste

A.3.26.1 Attributs

Le Tableau A.41 présente les attributs potentiels pour cet IDN.

Tableau A.41 – Attributs de l'IDN S-0-0395

Attribut	Valeur
Nom	Index de liste
Version	—
Longueur	2

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Attribut	Valeur
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.26.2 Description

Cet index de liste spécifie l'adresse de départ à l'intérieur de la liste. Avec l'index de liste = 0, l'accès au premier élément de liste est possible après l'indication des longueurs. L'index de liste est toujours programmé selon les éléments de liste.

- Index de liste = 0 -> 1. Elément de liste (longueur de 1, 2, 4 ou 8 octets)
- Index de liste = 1 -> 2. Elément de liste (longueur de 1, 2, 4 ou 8 octets), etc.

L'index de liste doit se situer entre le premier élément de liste et le dernier élément de liste +1. Il n'est pas possible d'insérer un espace dans une liste, mais il est en revanche possible d'étendre la liste à son extrémité jusqu'à sa longueur maximale.

A.3.27 IDN S-0-0396 Nombre d'éléments de liste

A.3.27.1 Attributs

Le Tableau A.42 présente les attributs potentiels pour cet IDN.

Tableau A.42 – Attributs de l'IDN S-0-0396

Attribut	Valeur
Nom	Nombre d'éléments de liste
Version	—
Longueur	2
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.27.2 Description

Ce paramètre archive le nombre d'éléments de liste qui doivent être transmis. Le nombre comptabilise les éléments de liste, et non les octets. Le calcul de la longueur en octets doit être effectué par l'appareil lui-même. Avec un accès en lecture, l'esclave génère la longueur actuelle en octets du segment de liste. Pour l'accès en écriture, ce paramètre doit être ignoré. Les informations concernant la longueur et relatives à l'accès en écriture sont archivées dans la longueur actuelle du segment de liste.

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A.3.28 IDN S-0-0397 Segment de liste

A.3.28.1 Attributs

Le Tableau A.43 présente les attributs potentiels pour cet IDN.

Tableau A.43 – Attributs de l'IDN S-0-0397

Attribut	Valeur
Nom	Segment de liste
Version	—
Longueur	comme les données configurées, variables
Format d'affichage	comme les données configurées
Valeur d'entrée minimale	comme les données configurées
Valeur d'entrée maximale	comme les données configurées
Positions après la décimale	comme les données configurées
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	comme les données configurées
Unité	

A.3.28.2 Description

Avec l'accès à cet IDN, l'esclave doit évaluer et sauvegarder le contenu des IDN S-0-0394, S-0-0395, et si nécessaire S-0-0396. Les modifications apportées à ces 3 paramètres ne deviennent effectives qu'en cas de changement d'élément dans la voie de service.

- Accès en lecture
  - L'esclave fournit une liste selon le contenu de l'index de liste et le nombre d'éléments de liste. La longueur actuelle est calculée par l'esclave (nombre d'éléments de liste * largeur de l'élément). La longueur maximale du segment de liste doit être réglée sur la longueur actuelle de la liste des IDN (S-0-0394).
  - L'accès à tout élément, à l'exception de l'élément 7, doit prévoir une reproduction de l'élément correspondant du paramètre archivé dans S-0-0394.
- Accès en écriture
  - L'IDN S-0-0396 doit être ignoré pour les accès en écriture.
  - La longueur actuelle du segment de liste doit être utilisée dans l'esclave.
  - Seul l'élément 7 doit être accessible en écriture.
  - Un accès en écriture se superpose aux éléments de liste existants. L'insertion de segments de liste dans la liste de destination ne doit pas être possible. Il est possible d'étendre une liste avec un segment de liste à l'extrémité de la liste jusqu'à sa longueur maximale.
  - Le segment de liste devient immédiatement effectif. Il se comporte comme si la liste complète avait été saisie.

A.3.29 IDN S-0-0398 Liste des IDN de bits en temps réel configurables en tant que producteur

A.3.29.1 Attributs

Le Tableau A.44 présente les attributs potentiels pour cet IDN.

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Tableau A.44 – Attributs de l'IDN S-0-0398

Attribut	Valeur
Nom	Liste des IDN de bits en temps réel configurables en tant que producteur
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.29.2 Description

Cette liste des IDN contient les numéros d'identification dont les bits sont configurables en tant que bits en temps réel dans une connexion du producteur.

A.3.30 IDN S-0-0399 Liste des IDN de bits en temps réel configurables en tant que consommateur

A.3.30.1 Attributs

Le Tableau A.45 présente les attributs potentiels pour cet IDN.

Tableau A.45 – Attributs de l'IDN S-0-0399

Attribut	Valeur
Nom	Liste des IDN de bits en temps réel configurables en tant que consommateur
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.30.2 Description

Cette liste des IDN contient les numéros d'identification dont les bits sont configurables en tant que bits en temps réel dans une connexion du consommateur.

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A.3.31 IDN S-0-0444 Liste des IDN de données configurables dans le conteneur de données AT

A.3.31.1 Attributs

Le Tableau A.46 présente les attributs potentiels pour cet IDN.

Tableau A.46 – Attributs de l'IDN S-0-0444

Attribut	Valeur
Nom	Liste des IDN de données configurables dans le conteneur de données AT
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.31.2 Description

Cette liste contient les IDN des données d'exploitation qui peuvent être traitées par le sous-appareil dans les conteneurs de données AT. Cette liste des IDN est utilisée dans le conteneur de données standard et étendu.

A.3.32 IDN S-0-0445 Liste des IDN de données configurables dans le conteneur de données MDT

A.3.32.1 Attributs

Le Tableau A.47 présente les attributs potentiels pour cet IDN.

Tableau A.47 – Attributs de l'IDN S-0-0445

Attribut	Valeur
Nom	Liste des IDN de données configurables dans le conteneur de données MDT
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

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A.3.32.2 Description

Cette liste contient les IDN des données d'exploitation qui peuvent être traitées par le sous-appareil dans les conteneurs de données MDT. Cette liste des IDN est utilisée dans le conteneur de données standard et étendu.

A.3.33 IDN S-0-0450 Conteneur A2 de données MDT

A.3.33.1 Attributs

Le Tableau A.48 présente les attributs potentiels pour cet IDN.

Tableau A.48 – Attributs de l'IDN S-0-0450

Attribut	Valeur
Nom	Conteneur A2 de données MDT
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.33.2 Description

Pour la fonction du conteneur de données étendu dans le MDT,

- huit conteneurs de données (longueur de 4 octets, A1 à A8) et
- deux conteneurs de données (longueur de 8 octets, A9 et A10)

sont définis, et utilisés comme paramètres fictifs dans le MDT. Le maître peut, si nécessaire, modifier le contenu des conteneurs de données de manière dynamique. De plus, le pointeur de conteneurs A de données (S-0-0368) est requis pour les conteneurs A1 à A10 (S-0-0360, S-0-0450 à S-0-0458), ainsi qu'une liste de configuration (S-0-0370, S-0-0490 à S-0-0498) pour chacun des conteneurs MDT. Lorsque les données d'exploitation configurées ont une longueur de 2 ou 4 octets seulement, elles sont placées dans la partie inférieure du conteneur de données MDT. La partie supérieure n'est pas utilisée.

Pour la configuration des données d'exploitation dans le conteneur de données, l'esclave peut choisir entre une exigence minimale et une exigence maximale.

- Bloc de données requis minimal (accès via la voie de service):
  - Les données d'exploitation configurées sont représentées dans le conteneur de données au format hexadécimal, sans les unités.
    - Attribut: Le type de données et le format d'affichage sont définis au format hexadécimal (bits 22-20 = 011)
    - Unités: Inexistantes
- Bloc de données requis maximal (accès via la voie de service):

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– Les données d'exploitation configurées sont représentées dans le conteneur de données, mais non avec le bloc de données du conteneur de données proprement dit, mais plutôt avec le bloc des données d'exploitation configurées. Dans ce cas, les données d'exploitation sont affichées avec l'IDN du conteneur de données, exactement de la même manière qu'elles le seraient avec leurs propres IDN.

A.3.34 IDN S-0-0451 Conteneur A3 de données MDT

A.3.34.1 Attributs

Le Tableau A.49 présente les attributs potentiels pour cet IDN.

Tableau A.49 – Attributs de l'IDN S-0-0451

Attribut	Valeur
Nom	Conteneur A3 de données MDT
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.34.2 Description

Pour la fonction du conteneur de données étendu dans le MDT,

- huit conteneurs de données (longueur de 4 octets, A1 à A8) et
- deux conteneurs de données (longueur de 8 octets, A9 et A10)

sont définis, et utilisés comme paramètres fictifs dans le MDT. Le maître peut, si nécessaire, modifier le contenu des conteneurs de données de manière dynamique. De plus, le pointeur de conteneurs A de données (S-0-0368) est requis pour les conteneurs A1 à A10 (S-0-0360, S-0-0450 à S-0-0458), ainsi qu'une liste de configuration (S-0-0370, S-0-0490 à S-0-0498) pour chacun des conteneurs MDT. Lorsque les données d'exploitation configurées ont une longueur de 2 ou 4 octets seulement, elles sont placées dans la partie inférieure du conteneur de données MDT. La partie supérieure n'est pas utilisée.

Pour la configuration des données d'exploitation dans le conteneur de données, l'esclave peut choisir entre une exigence minimale et une exigence maximale.

- Bloc de données requis minimal (accès via la voie de service):
  – Les données d'exploitation configurées sont représentées dans le conteneur de données au format hexadécimal, sans les unités.
    - Attribut: Le type de données et le format d'affichage sont définis au format hexadécimal (bits 22-20 = 011)
    - Unités: Inexistantes
- Bloc de données requis maximal (accès via la voie de service):
  – Les données d'exploitation configurées sont représentées dans le conteneur de données, mais non avec le bloc de données du conteneur de données proprement dit,

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mais plutôt avec le bloc des données d'exploitation configurées. Dans ce cas, les données d'exploitation sont affichées avec l'IDN du conteneur de données, exactement de la même manière qu'elles le seraient avec leurs propres IDN.

A.3.35 IDN S-0-0452 Conteneur A4 de données MDT

A.3.35.1 Attributs

Le Tableau A.50 présente les attributs potentiels pour cet IDN.

Tableau A.50 – Attributs de l'IDN S-0-0452

Attribut	Valeur
Nom	Conteneur A4 de données MDT
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.35.2 Description

Pour la fonction du conteneur de données étendu dans le MDT,

- huit conteneurs de données (longueur de 4 octets, A1 à A8) et
- deux conteneurs de données (longueur de 8 octets, A9 et A10)

sont définis, et utilisés comme paramètres fictifs dans le MDT. Le maître peut, si nécessaire, modifier le contenu des conteneurs de données de manière dynamique. De plus, le pointeur de conteneurs A de données (S-0-0368) est requis pour les conteneurs A1 à A10 (S-0-0360, S-0-0450 à S-0-0458), ainsi qu'une liste de configuration (S-0-0370, S-0-0490 à S-0-0498) pour chacun des conteneurs MDT. Lorsque les données d'exploitation configurées ont une longueur de 2 ou 4 octets seulement, elles sont placées dans la partie inférieure du conteneur de données MDT. La partie supérieure n'est pas utilisée.

Pour la configuration des données d'exploitation dans le conteneur de données, l'esclave peut choisir entre une exigence minimale et une exigence maximale.

- Bloc de données requis minimal (accès via la voie de service):
  – Les données d'exploitation configurées sont représentées dans le conteneur de données au format hexadécimal, sans les unités.
    - Attribut: Le type de données et le format d'affichage sont définis au format hexadécimal (bits 22-20 = 011)
    - Unités: Inexistantes
- Bloc de données requis maximal (accès via la voie de service):
  – Les données d'exploitation configurées sont représentées dans le conteneur de données, mais non avec le bloc de données du conteneur de données proprement dit, mais plutôt avec le bloc des données d'exploitation configurées. Dans ce cas, les

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données d'exploitation sont affichées avec l'IDN du conteneur de données, exactement de la même manière qu'elles le seraient avec leurs propres IDN.

A.3.36 IDN S-0-0453 Conteneur A5 de données MDT

A.3.36.1 Attributs

Le Tableau A.51 présente les attributs potentiels pour cet IDN.

Tableau A.51 – Attributs de l'IDN S-0-0453

Attribut	Valeur
Nom	Conteneur A5 de données MDT
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.36.2 Description

Pour la fonction du conteneur de données étendu dans le MDT,

- huit conteneurs de données (longueur de 4 octets, A1 à A8) et
- deux conteneurs de données (longueur de 8 octets, A9 et A10)

sont définis, et utilisés comme paramètres fictifs dans le MDT. Le maître peut, si nécessaire, modifier le contenu des conteneurs de données de manière dynamique. De plus, le pointeur de conteneurs A de données (S-0-0368) est requis pour les conteneurs A1 à A10 (S-0-0360, S-0-0450 à S-0-0458), ainsi qu'une liste de configuration (S-0-0370, S-0-0490 à S-0-0498) pour chacun des conteneurs MDT. Lorsque les données d'exploitation configurées ont une longueur de 2 ou 4 octets seulement, elles sont placées dans la partie inférieure du conteneur de données MDT. La partie supérieure n'est pas utilisée.

Pour la configuration des données d'exploitation dans le conteneur de données, l'esclave peut choisir entre une exigence minimale et une exigence maximale.

- Bloc de données requis minimal (accès via la voie de service):
  – Les données d'exploitation configurées sont représentées dans le conteneur de données au format hexadécimal, sans les unités.
    - Attribut: Le type de données et le format d'affichage sont définis au format hexadécimal (bits 22-20 = 011)
    - Unités: Inexistantes
- Bloc de données requis maximal (accès via la voie de service):
  – Les données d'exploitation configurées sont représentées dans le conteneur de données, mais non avec le bloc de données du conteneur de données proprement dit, mais plutôt avec le bloc des données d'exploitation configurées. Dans ce cas, les données d'exploitation sont affichées avec l'IDN du conteneur de données, exactement de la même manière qu'elles le seraient avec leurs propres IDN.

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A.3.37 IDN S-0-0454 Conteneur A6 de données MDT

A.3.37.1 Attributs

Le Tableau A.52 présente les attributs potentiels pour cet IDN.

Tableau A.52 – Attributs de l'IDN S-0-0454

Attribut	Valeur
Nom	Conteneur A6 de données MDT
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.37.2 Description

Pour la fonction du conteneur de données étendu dans le MDT,

- huit conteneurs de données (longueur de 4 octets, A1 à A8) et
- deux conteneurs de données (longueur de 8 octets, A9 et A10)

sont définis, et utilisés comme paramètres fictifs dans le MDT. Le maître peut, si nécessaire, modifier le contenu des conteneurs de données de manière dynamique. De plus, le pointeur de conteneurs A de données (S-0-0368) est requis pour les conteneurs A1 à A10 (S-0-0360, S-0-0450 à S-0-0458), ainsi qu'une liste de configuration (S-0-0370, S-0-0490 à S-0-0498) pour chacun des conteneurs MDT. Lorsque les données d'exploitation configurées ont une longueur de 2 ou 4 octets seulement, elles sont placées dans la partie inférieure du conteneur de données MDT. La partie supérieure n'est pas utilisée.

Pour la configuration des données d'exploitation dans le conteneur de données, l'esclave peut choisir entre une exigence minimale et une exigence maximale.

- Bloc de données requis minimal (accès via la voie de service):
  - Les données d'exploitation configurées sont représentées dans le conteneur de données au format hexadécimal, sans les unités.
    - Attribut: Le type de données et le format d'affichage sont définis au format hexadécimal (bits 22-20 = 011)
    - Unités: Inexistantes
- Bloc de données requis maximal (accès via la voie de service):
  - Les données d'exploitation configurées sont représentées dans le conteneur de données, mais non avec le bloc de données du conteneur de données proprement dit, mais plutôt avec le bloc des données d'exploitation configurées. Dans ce cas, les données d'exploitation sont affichées avec l'IDN du conteneur de données, exactement de la même manière qu'elles le seraient avec leurs propres IDN.

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A.3.38 IDN S-0-0455 Conteneur A7 de données MDT

A.3.38.1 Attributs

Le Tableau A.53 présente les attributs potentiels pour cet IDN.

Tableau A.53 – Attributs de l'IDN S-0-0455

Attribut	Valeur
Nom	Conteneur A7 de données MDT
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.38.2 Description

Pour la fonction du conteneur de données étendu dans le MDT,

- huit conteneurs de données (longueur de 4 octets, A1 à A8) et
- deux conteneurs de données (longueur de 8 octets, A9 et A10)

sont définis, et utilisés comme paramètres fictifs dans le MDT. Le maître peut, si nécessaire, modifier le contenu des conteneurs de données de manière dynamique. De plus, le pointeur de conteneurs A de données (S-0-0368) est requis pour les conteneurs A1 à A10 (S-0-0360, S-0-0450 à S-0-0458), ainsi qu'une liste de configuration (S-0-0370, S-0-0490 à S-0-0498) pour chacun des conteneurs MDT. Lorsque les données d'exploitation configurées ont une longueur de 2 ou 4 octets seulement, elles sont placées dans la partie inférieure du conteneur de données MDT. La partie supérieure n'est pas utilisée.

Pour la configuration des données d'exploitation dans le conteneur de données, l'esclave peut choisir entre une exigence minimale et une exigence maximale.

- Bloc de données requis minimal (accès via la voie de service):
  - Les données d'exploitation configurées sont représentées dans le conteneur de données au format hexadécimal, sans les unités.
    - Attribut: Le type de données et le format d'affichage sont définis au format hexadécimal (bits 22-20 = 011)
    - Unités: Inexistantes
- Bloc de données requis maximal (accès via la voie de service):
  - Les données d'exploitation configurées sont représentées dans le conteneur de données, mais non avec le bloc de données du conteneur de données proprement dit, mais plutôt avec le bloc des données d'exploitation configurées. Dans ce cas, les données d'exploitation sont affichées avec l'IDN du conteneur de données, exactement de la même manière qu'elles le seraient avec leurs propres IDN.

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A.3.39 IDN S-0-0456 Conteneur A8 de données MDT

A.3.39.1 Attributs

Le Tableau A.54 présente les attributs potentiels pour cet IDN.

Tableau A.54 – Attributs de l'IDN S-0-0456

Attribut	Valeur
Nom	Conteneur A8 de données MDT
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.39.2 Description

Pour la fonction du conteneur de données étendu dans le MDT,

- huit conteneurs de données (longueur de 4 octets, A1 à A8) et
- deux conteneurs de données (longueur de 8 octets, A9 et A10)

sont définis, et utilisés comme paramètres fictifs dans le MDT. Le maître peut, si nécessaire, modifier le contenu des conteneurs de données de manière dynamique. De plus, le pointeur de conteneurs A de données (S-0-0368) est requis pour les conteneurs A1 à A10 (S-0-0360, S-0-0450 à S-0-0458), ainsi qu'une liste de configuration (S-0-0370, S-0-0490 à S-0-0498) pour chacun des conteneurs MDT. Lorsque les données d'exploitation configurées ont une longueur de 2 ou 4 octets seulement, elles sont placées dans la partie inférieure du conteneur de données MDT. La partie supérieure n'est pas utilisée.

Pour la configuration des données d'exploitation dans le conteneur de données, l'esclave peut choisir entre une exigence minimale et une exigence maximale.

- Bloc de données requis minimal (accès via la voie de service):
  - Les données d'exploitation configurées sont représentées dans le conteneur de données au format hexadécimal, sans les unités.
    - Attribut: Le type de données et le format d'affichage sont définis au format hexadécimal (bits 22-20 = 011)
    - Unités: Inexistantes
- Bloc de données requis maximal (accès via la voie de service):
  - Les données d'exploitation configurées sont représentées dans le conteneur de données, mais non avec le bloc de données du conteneur de données proprement dit, mais plutôt avec le bloc des données d'exploitation configurées. Dans ce cas, les données d'exploitation sont affichées avec l'IDN du conteneur de données, exactement de la même manière qu'elles le seraient avec leurs propres IDN.

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A.3.40 IDN S-0-0457 Conteneur A9 de données MDT

A.3.40.1 Attributs

Le Tableau A.55 présente les attributs potentiels pour cet IDN.

Tableau A.55 – Attributs de l'IDN S-0-0457

Attribut	Valeur
Nom	Conteneur A9 de données MDT
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.40.2 Description

Pour la fonction du conteneur de données étendu dans le MDT,

- huit conteneurs de données (longueur de 4 octets, A1 à A8) et
- deux conteneurs de données (longueur de 8 octets, A9 et A10)

sont définis, et utilisés comme paramètres fictifs dans le MDT. Le maître peut, si nécessaire, modifier le contenu des conteneurs de données de manière dynamique. De plus, le pointeur de conteneurs A de données (S-0-0368) est requis pour les conteneurs A1 à A10 (S-0-0360, S-0-0450 à S-0-0458), ainsi qu'une liste de configuration (S-0-0370, S-0-0490 à S-0-0498) pour chacun des conteneurs MDT. Lorsque les données d'exploitation configurées ont une longueur de 2 ou 4 octets seulement, elles sont placées dans la partie inférieure du conteneur de données MDT. La partie supérieure n'est pas utilisée.

Pour la configuration des données d'exploitation dans le conteneur de données, l'esclave peut choisir entre une exigence minimale et une exigence maximale.

- Bloc de données requis minimal (accès via la voie de service):
  - Les données d'exploitation configurées sont représentées dans le conteneur de données au format hexadécimal, sans les unités.
    - Attribut: Le type de données et le format d'affichage sont définis au format hexadécimal (bits 22-20 = 011)
    - Unités: Inexistantes
- Bloc de données requis maximal (accès via la voie de service):
  - Les données d'exploitation configurées sont représentées dans le conteneur de données, mais non avec le bloc de données du conteneur de données proprement dit, mais plutôt avec le bloc des données d'exploitation configurées. Dans ce cas, les données d'exploitation sont affichées avec l'IDN du conteneur de données, exactement de la même manière qu'elles le seraient avec leurs propres IDN.

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A.3.41 IDN S-0-0458 Conteneur A10 de données MDT

A.3.41.1 Attributs

Le Tableau A.56 présente les attributs potentiels pour cet IDN.

Tableau A.56 – Attributs de l'IDN S-0-0458

Attribut	Valeur
Nom	Conteneur A10 de données MDT
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.41.2 Description

Pour la fonction du conteneur de données étendu dans le MDT,

- huit conteneurs de données (longueur de 4 octets, A1 à A8) et
- deux conteneurs de données (longueur de 8 octets, A9 et A10)

sont définis, et utilisés comme paramètres fictifs dans le MDT. Le maître peut, si nécessaire, modifier le contenu des conteneurs de données de manière dynamique. De plus, le pointeur de conteneurs A de données (S-0-0368) est requis pour les conteneurs A1 à A10 (S-0-0360, S-0-0450 à S-0-0458), ainsi qu'une liste de configuration (S-0-0370, S-0-0490 à S-0-0498) pour chacun des conteneurs MDT. Lorsque les données d'exploitation configurées ont une longueur de 2 ou 4 octets seulement, elles sont placées dans la partie inférieure du conteneur de données MDT. La partie supérieure n'est pas utilisée.

Pour la configuration des données d'exploitation dans le conteneur de données, l'esclave peut choisir entre une exigence minimale et une exigence maximale.

- Bloc de données requis minimal (accès via la voie de service):
  - Les données d'exploitation configurées sont représentées dans le conteneur de données au format hexadécimal, sans les unités.
    - Attribut: Le type de données et le format d'affichage sont définis au format hexadécimal (bits 22-20 = 011)
    - Unités: Inexistantes
- Bloc de données requis maximal (accès via la voie de service):
  - Les données d'exploitation configurées sont représentées dans le conteneur de données, mais non avec le bloc de données du conteneur de données proprement dit, mais plutôt avec le bloc des données d'exploitation configurées. Dans ce cas, les données d'exploitation sont affichées avec l'IDN du conteneur de données, exactement de la même manière qu'elles le seraient avec leurs propres IDN.

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A.3.42 IDN S-0-0459 Conteneur B2 de données MDT

A.3.42.1 Attributs

Le Tableau A.57 présente les attributs potentiels pour cet IDN.

Tableau A.57 – Attributs de l'IDN S-0-0459

Attribut	Valeur
Nom	Conteneur B2 de données MDT
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.42.2 Description

Pour la fonction du conteneur de données étendu dans le MDT,

- huit conteneurs de données (longueur de 4 octets, A1 à A8) et
- deux conteneurs de données (longueur de 8 octets, A9 et A10)

sont définis, et utilisés comme paramètres fictifs dans le MDT. Le maître peut, si nécessaire, modifier le contenu des conteneurs de données de manière dynamique. De plus, le pointeur de conteneurs A de données (S-0-0368) est requis pour les conteneurs A1 à A10 (S-0-0360, S-0-0450 à S-0-0458), ainsi qu'une liste de configuration (S-0-0370, S-0-0490 à S-0-0498) pour chacun des conteneurs MDT. Lorsque les données d'exploitation configurées ont une longueur de 2 ou 4 octets seulement, elles sont placées dans la partie inférieure du conteneur de données MDT. La partie supérieure n'est pas utilisée.

Pour la configuration des données d'exploitation dans le conteneur de données, l'esclave peut choisir entre une exigence minimale et une exigence maximale.

- Bloc de données requis minimal (accès via la voie de service):
  - – Les données d'exploitation configurées sont représentées dans le conteneur de données au format hexadécimal, sans les unités.
    - Attribut: Le type de données et le format d'affichage sont définis au format hexadécimal (bits 22-20 = 011)
    - Unités: Inexistantes
- Bloc de données requis maximal (accès via la voie de service):
  - – Les données d'exploitation configurées sont représentées dans le conteneur de données, mais non avec le bloc de données du conteneur de données proprement dit, mais plutôt avec le bloc des données d'exploitation configurées. Dans ce cas, les données d'exploitation sont affichées avec l'IDN du conteneur de données, exactement de la même manière qu'elles le seraient avec leurs propres IDN.

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A.3.43 IDN S-0-0480 Conteneur A2 de données AT

A.3.43.1 Attributs

Le Tableau A.58 présente les attributs potentiels pour cet IDN.

Tableau A.58 – Attributs de l'IDN S-0-0480

Attribut	Valeur
Nom	Conteneur A2 de données AT
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.43.2 Description

Pour la fonction du conteneur de données standard dans l'AT,

- deux conteneurs de données (longueur de 4 octets, A1 et B1) et
- deux conteneurs de données (longueur de 8 octets, A9 et B2)

sont définis, et utilisés comme paramètres fictifs dans l'AT. Le maître peut, si nécessaire, modifier le contenu des conteneurs de données de manière dynamique. De plus, le pointeur de conteneurs A de données (S-0-0368) est requis pour les conteneurs A1 et A9 (S-0-0364 et S-0-0487). Le pointeur de conteneurs B de données (S-0-0369) est requis pour les conteneurs B1 et B2 (S-0-0365 et S-0-0489), ainsi qu'une liste de configuration (S-0-0371) pour tous les conteneurs AT. Lorsque les données d'exploitation configurées ont une longueur de 2 ou 4 octets seulement, elles sont placées dans la partie inférieure du conteneur de données AT. La partie supérieure n'est pas utilisée.

Pour la configuration des données d'exploitation dans le conteneur de données, l'esclave peut choisir entre une exigence minimale et une exigence maximale.

- Bloc de données requis minimal (accès via la voie de service):
  - Les données d'exploitation configurées sont représentées dans le conteneur de données au format hexadécimal, sans les unités.
    - Attribut: Le type de données et le format d'affichage sont définis au format hexadécimal (bits 22-20 = 011)
    - Unités: Inexistantes
- Bloc de données requis maximal (accès via la voie de service):
  - Les données d'exploitation configurées sont représentées dans le conteneur de données, mais non avec le bloc de données du conteneur de données proprement dit, mais plutôt avec le bloc des données d'exploitation configurées. Dans ce cas, les données d'exploitation sont affichées avec l'IDN du conteneur de données, exactement de la même manière qu'elles le seraient avec leurs propres IDN.

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NOTE Les conteneurs A1 (S-0-0364) et A9 (S-0-0487) de données AT sont utilisés également dans la fonction de conteneur de données étendu.

A.3.44 IDN S-0-0481 Conteneur A3 de données AT

A.3.44.1 Attributs

Le Tableau A.59 présente les attributs potentiels pour cet IDN.

Tableau A.59 – Attributs de l'IDN S-0-0481

Attribut	Valeur
Nom	Conteneur A3 de données AT
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.44.2 Description

Pour la fonction du conteneur de données standard dans l'AT,

- deux conteneurs de données (longueur de 4 octets, A1 et B1) et
- deux conteneurs de données (longueur de 8 octets, A9 et B2)

sont définis, et utilisés comme paramètres fictifs dans l'AT. Le maître peut, si nécessaire, modifier le contenu des conteneurs de données de manière dynamique. De plus, le pointeur de conteneurs A de données (S-0-0368) est requis pour les conteneurs A1 et A9 (S-0-0364 et S-0-0487). Le pointeur de conteneurs B de données (S-0-0369) est requis pour les conteneurs B1 et B2 (S-0-0365 et S-0-0489), ainsi qu'une liste de configuration (S-0-0371) pour tous les conteneurs AT. Lorsque les données d'exploitation configurées ont une longueur de 2 ou 4 octets seulement, elles sont placées dans la partie inférieure du conteneur de données AT. La partie supérieure n'est pas utilisée.

Pour la configuration des données d'exploitation dans le conteneur de données, l'esclave peut choisir entre une exigence minimale et une exigence maximale.

- Bloc de données requis minimal (accès via la voie de service):
  - Les données d'exploitation configurées sont représentées dans le conteneur de données au format hexadécimal, sans les unités.
    - Attribut: Le type de données et le format d'affichage sont définis au format hexadécimal (bits 22-20 = 011)
    - Unités: Inexistantes
- Bloc de données requis maximal (accès via la voie de service):
  - Les données d'exploitation configurées sont représentées dans le conteneur de données, mais non avec le bloc de données du conteneur de données proprement dit, mais plutôt avec le bloc des données d'exploitation configurées. Dans ce cas, les

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données d'exploitation sont affichées avec l'IDN du conteneur de données, exactement de la même manière qu'elles le seraient avec leurs propres IDN.

NOTE Les conteneurs A1 (S-0-0364) et A9 (S-0-0487) de données AT sont utilisés également dans la fonction de conteneur de données étendu.

A.3.45 IDN S-0-0482 Conteneur A4 de données AT

A.3.45.1 Attributs

Le Tableau A.60 présente les attributs potentiels pour cet IDN.

Tableau A.60 – Attributs de l'IDN S-0-0482

Attribut	Valeur
Nom	Conteneur A4 de données AT
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.45.2 Description

Pour la fonction du conteneur de données standard dans l'AT,

- deux conteneurs de données (longueur de 4 octets, A1 et B1) et
- deux conteneurs de données (longueur de 8 octets, A9 et B2)

sont définis, et utilisés comme paramètres fictifs dans l'AT. Le maître peut, si nécessaire, modifier le contenu des conteneurs de données de manière dynamique. De plus, le pointeur de conteneurs A de données (S-0-0368) est requis pour les conteneurs A1 et A9 (S-0-0364 et S-0-0487). Le pointeur de conteneurs B de données (S-0-0369) est requis pour les conteneurs B1 et B2 (S-0-0365 et S-0-0489), ainsi qu'une liste de configuration (S-0-0371) pour tous les conteneurs AT. Lorsque les données d'exploitation configurées ont une longueur de 2 ou 4 octets seulement, elles sont placées dans la partie inférieure du conteneur de données AT. La partie supérieure n'est pas utilisée.

Pour la configuration des données d'exploitation dans le conteneur de données, l'esclave peut choisir entre une exigence minimale et une exigence maximale.

- Bloc de données requis minimal (accès via la voie de service):
  - Les données d'exploitation configurées sont représentées dans le conteneur de données au format hexadécimal, sans les unités.
    - Attribut: Le type de données et le format d'affichage sont définis au format hexadécimal (bits 22-20 = 011)
    - Unités: Inexistantes
- Bloc de données requis maximal (accès via la voie de service):

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– Les données d'exploitation configurées sont représentées dans le conteneur de données, mais non avec le bloc de données du conteneur de données proprement dit, mais plutôt avec le bloc des données d'exploitation configurées. Dans ce cas, les données d'exploitation sont affichées avec l'IDN du conteneur de données, exactement de la même manière qu'elles le seraient avec leurs propres IDN.

NOTE Les conteneurs A1 (S-0-0364) et A9 (S-0-0487) de données AT sont utilisés également dans la fonction de conteneur de données étendu.

A.3.46 IDN S-0-0483 Conteneur A5 de données AT

A.3.46.1 Attributs

Le Tableau A.61 présente les attributs potentiels pour cet IDN.

Tableau A.61 – Attributs de l'IDN S-0-0483

Attribut	Valeur
Nom	Conteneur A5 de données AT
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.46.2 Description

Pour la fonction du conteneur de données standard dans l'AT,

- deux conteneurs de données (longueur de 4 octets, A1 et B1) et
- deux conteneurs de données (longueur de 8 octets, A9 et B2)

sont définis, et utilisés comme paramètres fictifs dans l'AT. Le maître peut, si nécessaire, modifier le contenu des conteneurs de données de manière dynamique. De plus, le pointeur de conteneurs A de données (S-0-0368) est requis pour les conteneurs A1 et A9 (S-0-0364 et S-0-0487). Le pointeur de conteneurs B de données (S-0-0369) est requis pour les conteneurs B1 et B2 (S-0-0365 et S-0-0489), ainsi qu'une liste de configuration (S-0-0371) pour tous les conteneurs AT. Lorsque les données d'exploitation configurées ont une longueur de 2 ou 4 octets seulement, elles sont placées dans la partie inférieure du conteneur de données AT. La partie supérieure n'est pas utilisée.

Pour la configuration des données d'exploitation dans le conteneur de données, l'esclave peut choisir entre une exigence minimale et une exigence maximale.

- Bloc de données requis minimal (accès via la voie de service):
  - Les données d'exploitation configurées sont représentées dans le conteneur de données au format hexadécimal, sans les unités.
    - Attribut: Le type de données et le format d'affichage sont définis au format hexadécimal (bits 22-20 = 011)
    - Unités: Inexistantes

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- Bloc de données requis maximal (accès via la voie de service):
  – Les données d'exploitation configurées sont représentées dans le conteneur de données, mais non avec le bloc de données du conteneur de données proprement dit, mais plutôt avec le bloc des données d'exploitation configurées. Dans ce cas, les données d'exploitation sont affichées avec l'IDN du conteneur de données, exactement de la même manière qu'elles le seraient avec leurs propres IDN.

NOTE Les conteneurs A1 (S-0-0364) et A9 (S-0-0487) de données AT sont utilisés également dans la fonction de conteneur de données étendu.

A.3.47 IDN S-0-0484 Conteneur A6 de données AT

A.3.47.1 Attributs

Le Tableau A.62 présente les attributs potentiels pour cet IDN.

Tableau A.62 – Attributs de l'IDN S-0-0484

Attribut	Valeur
Nom	Conteneur A6 de données AT
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.47.2 Description

Pour la fonction du conteneur de données standard dans l'AT,

- deux conteneurs de données (longueur de 4 octets, A1 et B1) et
- deux conteneurs de données (longueur de 8 octets, A9 et B2)

sont définis, et utilisés comme paramètres fictifs dans l'AT. Le maître peut, si nécessaire, modifier le contenu des conteneurs de données de manière dynamique. De plus, le pointeur de conteneurs A de données (S-0-0368) est requis pour les conteneurs A1 et A9 (S-0-0364 et S-0-0487). Le pointeur de conteneurs B de données (S-0-0369) est requis pour les conteneurs B1 et B2 (S-0-0365 et S-0-0489), ainsi qu'une liste de configuration (S-0-0371) pour tous les conteneurs AT. Lorsque les données d'exploitation configurées ont une longueur de 2 ou 4 octets seulement, elles sont placées dans la partie inférieure du conteneur de données AT. La partie supérieure n'est pas utilisée.

Pour la configuration des données d'exploitation dans le conteneur de données, l'esclave peut choisir entre une exigence minimale et une exigence maximale.

- Bloc de données requis minimal (accès via la voie de service):
  – Les données d'exploitation configurées sont représentées dans le conteneur de données au format hexadécimal, sans les unités.
    - Attribut: Le type de données et le format d'affichage sont définis au format hexadécimal (bits 22-20 = 011)

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- Unités: Inexistantes

- Bloc de données requis maximal (accès via la voie de service):
  – Les données d'exploitation configurées sont représentées dans le conteneur de données, mais non avec le bloc de données du conteneur de données proprement dit, mais plutôt avec le bloc des données d'exploitation configurées. Dans ce cas, les données d'exploitation sont affichées avec l'IDN du conteneur de données, exactement de la même manière qu'elles le seraient avec leurs propres IDN.

NOTE Les conteneurs A1 (S-0-0364) et A9 (S-0-0487) de données AT sont utilisés également dans la fonction de conteneur de données étendu.

A.3.48 IDN S-0-0485 Conteneur A7 de données AT

A.3.48.1 Attributs

Le Tableau A.63 présente les attributs potentiels pour cet IDN.

Tableau A.63 – Attributs de l'IDN S-0-0485

Attribut	Valeur
Nom	Conteneur A7 de données AT
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.48.2 Description

Pour la fonction du conteneur de données standard dans l'AT,

- deux conteneurs de données (longueur de 4 octets, A1 et B1) et
- deux conteneurs de données (longueur de 8 octets, A9 et B2)

sont définis, et utilisés comme paramètres fictifs dans l'AT. Le maître peut, si nécessaire, modifier le contenu des conteneurs de données de manière dynamique. De plus, le pointeur de conteneurs A de données (S-0-0368) est requis pour les conteneurs A1 et A9 (S-0-0364 et S-0-0487). Le pointeur de conteneurs B de données (S-0-0369) est requis pour les conteneurs B1 et B2 (S-0-0365 et S-0-0489), ainsi qu'une liste de configuration (S-0-0371) pour tous les conteneurs AT. Lorsque les données d'exploitation configurées ont une longueur de 2 ou 4 octets seulement, elles sont placées dans la partie inférieure du conteneur de données AT. La partie supérieure n'est pas utilisée.

Pour la configuration des données d'exploitation dans le conteneur de données, l'esclave peut choisir entre une exigence minimale et une exigence maximale.

- Bloc de données requis minimal (accès via la voie de service):
  – Les données d'exploitation configurées sont représentées dans le conteneur de données au format hexadécimal, sans les unités.

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- Attribut: Le type de données et le format d'affichage sont définis au format hexadécimal (bits 22-20 = 011)
- Unités: Inexistantes

- Bloc de données requis maximal (accès via la voie de service):
  – Les données d'exploitation configurées sont représentées dans le conteneur de données, mais non avec le bloc de données du conteneur de données proprement dit, mais plutôt avec le bloc des données d'exploitation configurées. Dans ce cas, les données d'exploitation sont affichées avec l'IDN du conteneur de données, exactement de la même manière qu'elles le seraient avec leurs propres IDN.

NOTE Les conteneurs A1 (S-0-0364) et A9 (S-0-0487) de données AT sont utilisés également dans la fonction de conteneur de données étendu.

A.3.49 IDN S-0-0486 Conteneur A8 de données AT

A.3.49.1 Attributs

Le Tableau A.64 présente les attributs potentiels pour cet IDN.

Tableau A.64 – Attributs de l'IDN S-0-0486

Attribut	Valeur
Nom	Conteneur A8 de données AT
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.49.2 Description

Pour la fonction du conteneur de données standard dans l'AT,

- deux conteneurs de données (longueur de 4 octets, A1 et B1) et
- deux conteneurs de données (longueur de 8 octets, A9 et B2)

sont définis, et utilisés comme paramètres fictifs dans l'AT. Le maître peut, si nécessaire, modifier le contenu des conteneurs de données de manière dynamique. De plus, le pointeur de conteneurs A de données (S-0-0368) est requis pour les conteneurs A1 et A9 (S-0-0364 et S-0-0487). Le pointeur de conteneurs B de données (S-0-0369) est requis pour les conteneurs B1 et B2 (S-0-0365 et S-0-0489), ainsi qu'une liste de configuration (S-0-0371) pour tous les conteneurs AT. Lorsque les données d'exploitation configurées ont une longueur de 2 ou 4 octets seulement, elles sont placées dans la partie inférieure du conteneur de données AT. La partie supérieure n'est pas utilisée.

Pour la configuration des données d'exploitation dans le conteneur de données, l'esclave peut choisir entre une exigence minimale et une exigence maximale.

- Bloc de données requis minimal (accès via la voie de service):

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  - Les données d'exploitation configurées sont représentées dans le conteneur de données au format hexadécimal, sans les unités.
    - Attribut: Le type de données et le format d'affichage sont définis au format hexadécimal (bits 22-20 = 011)
    - Unités: Inexistantes
- Bloc de données requis maximal (accès via la voie de service):
  - Les données d'exploitation configurées sont représentées dans le conteneur de données, mais non avec le bloc de données du conteneur de données proprement dit, mais plutôt avec le bloc des données d'exploitation configurées. Dans ce cas, les données d'exploitation sont affichées avec l'IDN du conteneur de données, exactement de la même manière qu'elles le seraient avec leurs propres IDN.

NOTE Les conteneurs A1 (S-0-0364) et A9 (S-0-0487) de données AT sont utilisés également dans la fonction de conteneur de données étendu.

A.3.50 IDN S-0-0487 Conteneur A9 de données AT

A.3.50.1 Attributs

Le Tableau A.65 présente les attributs potentiels pour cet IDN.

Tableau A.65 – Attributs de l'IDN S-0-0487

Attribut	Valeur
Nom	Conteneur A9 de données AT
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.50.2 Description

Pour la fonction du conteneur de données standard dans l'AT,

- deux conteneurs de données (longueur de 4 octets, A1 et B1) et
- deux conteneurs de données (longueur de 8 octets, A9 et B2)

sont définis, et utilisés comme paramètres fictifs dans l'AT. Le maître peut, si nécessaire, modifier le contenu des conteneurs de données de manière dynamique. De plus, le pointeur de conteneurs A de données (S-0-0368) est requis pour les conteneurs A1 et A9 (S-0-0364 et S-0-0487). Le pointeur de conteneurs B de données (S-0-0369) est requis pour les conteneurs B1 et B2 (S-0-0365 et S-0-0489), ainsi qu'une liste de configuration (S-0-0371) pour tous les conteneurs AT. Lorsque les données d'exploitation configurées ont une longueur de 2 ou 4 octets seulement, elles sont placées dans la partie inférieure du conteneur de données AT. La partie supérieure n'est pas utilisée.

Pour la configuration des données d'exploitation dans le conteneur de données, l'esclave peut choisir entre une exigence minimale et une exigence maximale.

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- Bloc de données requis minimal (accès via la voie de service):
  – Les données d'exploitation configurées sont représentées dans le conteneur de données au format hexadécimal, sans les unités.
    - Attribut: Le type de données et le format d'affichage sont définis au format hexadécimal (bits 22-20 = 011)
    - Unités: Inexistantes
- Bloc de données requis maximal (accès via la voie de service):
  – Les données d'exploitation configurées sont représentées dans le conteneur de données, mais non avec le bloc de données du conteneur de données proprement dit, mais plutôt avec le bloc des données d'exploitation configurées. Dans ce cas, les données d'exploitation sont affichées avec l'IDN du conteneur de données, exactement de la même manière qu'elles le seraient avec leurs propres IDN.

NOTE Les conteneurs A1 (S-0-0364) et A9 (S-0-0487) de données AT sont utilisés également dans la fonction de conteneur de données étendu.

A.3.51 IDN S-0-0488 Conteneur A10 de données AT

A.3.51.1 Attributs

Le Tableau A.66 présente les attributs potentiels pour cet IDN.

Tableau A.66 – Attributs de l'IDN S-0-0488

Attribut	Valeur
Nom	Conteneur A10 de données AT
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.51.2 Description

Pour la fonction du conteneur de données standard dans l'AT,

- deux conteneurs de données (longueur de 4 octets, A1 et B1) et
- deux conteneurs de données (longueur de 8 octets, A9 et B2)

sont définis, et utilisés comme paramètres fictifs dans l'AT. Le maître peut, si nécessaire, modifier le contenu des conteneurs de données de manière dynamique. De plus, le pointeur de conteneurs A de données (S-0-0368) est requis pour les conteneurs A1 et A9 (S-0-0364 et S-0-0487). Le pointeur de conteneurs B de données (S-0-0369) est requis pour les conteneurs B1 et B2 (S-0-0365 et S-0-0489), ainsi qu'une liste de configuration (S-0-0371) pour tous les conteneurs AT. Lorsque les données d'exploitation configurées ont une longueur de 2 ou 4 octets seulement, elles sont placées dans la partie inférieure du conteneur de données AT. La partie supérieure n'est pas utilisée.

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Pour la configuration des données d'exploitation dans le conteneur de données, l'esclave peut choisir entre une exigence minimale et une exigence maximale.

- Bloc de données requis minimal (accès via la voie de service):
  – Les données d'exploitation configurées sont représentées dans le conteneur de données au format hexadécimal, sans les unités.
    - Attribut: Le type de données et le format d'affichage sont définis au format hexadécimal (bits 22-20 = 011)
    - Unités: Inexistantes
- Bloc de données requis maximal (accès via la voie de service):
  – Les données d'exploitation configurées sont représentées dans le conteneur de données, mais non avec le bloc de données du conteneur de données proprement dit, mais plutôt avec le bloc des données d'exploitation configurées. Dans ce cas, les données d'exploitation sont affichées avec l'IDN du conteneur de données, exactement de la même manière qu'elles le seraient avec leurs propres IDN.

NOTE Les conteneurs A1 (S-0-0364) et A9 (S-0-0487) de données AT sont utilisés également dans la fonction de conteneur de données étendu.

A.3.52 IDN S-0-0489 Conteneur B de données AT

A.3.52.1 Attributs

Le Tableau A.67 présente les attributs potentiels pour cet IDN.

Tableau A.67 – Attributs de l'IDN S-0-0489

Attribut	Valeur
Nom	Conteneur B de données AT
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.52.2 Description

Pour la fonction du conteneur de données standard dans l'AT,

- deux conteneurs de données (longueur de 4 octets, A1 et B1) et
- deux conteneurs de données (longueur de 8 octets, A9 et B2) et

sont définis, et utilisés comme paramètres fictifs dans l'AT. Le maître peut, si nécessaire, modifier le contenu des conteneurs de données de manière dynamique. De plus, le pointeur de conteneurs A de données (S-0-0368) est requis pour les conteneurs A1 et A9 (S-0-0364 et S-0-0487). Le pointeur de conteneurs B de données (S-0-0369) est requis pour les conteneurs B1 et B2 (S-0-0365 et S-0-0489), ainsi qu'une liste de configuration (S-0-0371) pour tous les conteneurs AT. Lorsque les données d'exploitation configurées ont une longueur de 2 ou 4 octets seulement, elles sont placées dans la partie inférieure du conteneur de données AT. La partie supérieure n'est pas utilisée.

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Pour la configuration des données d'exploitation dans le conteneur de données, l'esclave peut choisir entre une exigence minimale et une exigence maximale.

- Bloc de données requis minimal (accès via la voie de service):
  - Les données d'exploitation configurées sont représentées dans le conteneur de données au format hexadécimal, sans les unités.
    - Attribut: Le type de données et le format d'affichage sont définis au format hexadécimal (bits 22-20 = 011)
    - Unités: Inexistantes
- Bloc de données requis maximal (accès via la voie de service):
  - Les données d'exploitation configurées sont représentées dans le conteneur de données, mais non avec le bloc de données du conteneur de données proprement dit, mais plutôt avec le bloc des données d'exploitation configurées. Dans ce cas, les données d'exploitation sont affichées avec l'IDN du conteneur de données, exactement de la même manière qu'elles le seraient avec leurs propres IDN.

NOTE Les conteneurs A1 (S-0-0364) et A9 (S-0-0487) de données AT sont utilisés également dans la fonction de conteneur de données étendu.

A.3.53 IDN S-0-0490 Liste de configuration de conteneurs A2 de données MDT

A.3.53.1 Attributs

Le Tableau A.68 présente les attributs potentiels pour cet IDN.

Tableau A.68 – Attributs de l'IDN S-0-0490

Attribut	Valeur
Nom	Liste de configuration de conteneurs A2 de données MDT
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.53.2 Description

Le maître saisit, dans la liste de configuration des conteneurs de données MDT, les numéros IDN relatifs aux données d'exploitation à envoyer via les conteneurs de données MDT correspondants (A et B du conteneur de données standard, et A1 à A10 du conteneur de données étendu), si nécessaire entre le maître et l'esclave.

Les IDN de cette liste des IDN peuvent provenir de S-0-0445 Liste des IDN de données configurables dans le conteneur de données MDT ou de S-0-0188 Liste des IDN de données configurables en tant que consommateur, en l'absence de S-0-0445.

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A.3.54 IDN S-0-0491 Liste de configuration de conteneurs A3 de données MDT

A.3.54.1 Attributs

Le Tableau A.69 présente les attributs potentiels pour cet IDN.

Tableau A.69 – Attributs de l'IDN S-0-0491

Attribut	Valeur
Nom	Liste de configuration de conteneurs A3 de données MDT
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.54.2 Description

Le maître saisit, dans la liste de configuration des conteneurs de données MDT, les numéros IDN relatifs aux données d'exploitation à envoyer via les conteneurs de données MDT correspondants (A et B du conteneur de données standard, et A1 à A10 du conteneur de données étendu), si nécessaire entre le maître et l'esclave.

Les IDN de cette liste des IDN peuvent provenir de S-0-0445 Liste des IDN de données configurables dans le conteneur de données MDT ou de S-0-0188 Liste des IDN de données configurables en tant que consommateur, en l'absence de S-0-0445.

A.3.55 IDN S-0-0492 Liste de configuration de conteneurs A4 de données MDT

A.3.55.1 Attributs

Le Tableau A.70 présente les attributs potentiels pour cet IDN.

Tableau A.70 – Attributs de l'IDN S-0-0492

Attribut	Valeur
Nom	Liste de configuration de conteneurs A4 de données MDT
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

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A.3.55.2 Description

Le maître saisit, dans la liste de configuration des conteneurs de données MDT, les numéros IDN relatifs aux données d'exploitation à envoyer via les conteneurs de données MDT correspondants (A et B du conteneur de données standard, et A1 à A10 du conteneur de données étendu), si nécessaire entre le maître et l'esclave.

Les IDN de cette liste des IDN peuvent provenir de S-0-0445 Liste des IDN de données configurables dans le conteneur de données MDT ou de S-0-0188 Liste des IDN de données configurables en tant que consommateur, en l'absence de S-0-0445.

A.3.56 IDN S-0-0493 Liste de configuration de conteneurs A5 de données MDT

A.3.56.1 Attributs

Le Tableau A.71 présente les attributs potentiels pour cet IDN.

Tableau A.71 – Attributs de l'IDN S-0-0493

Attribut	Valeur
Nom	Liste de configuration de conteneurs A5 de données MDT
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.56.2 Description

Le maître saisit, dans la liste de configuration des conteneurs de données MDT, les numéros IDN relatifs aux données d'exploitation à envoyer via les conteneurs de données MDT correspondants (A et B du conteneur de données standard, et A1 à A10 du conteneur de données étendu), si nécessaire entre le maître et l'esclave.

Les IDN de cette liste des IDN peuvent provenir de S-0-0445 Liste des IDN de données configurables dans le conteneur de données MDT ou de S-0-0188 Liste des IDN de données configurables en tant que consommateur, en l'absence de S-0-0445.

A.3.57 IDN S-0-0494 Liste de configuration de conteneurs A6 de données MDT

A.3.57.1 Attributs

Le Tableau A.72 présente les attributs potentiels pour cet IDN.

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Tableau A.72 – Attributs de l'IDN S-0-0494

Attribut	Valeur
Nom	Liste de configuration de conteneurs A6 de données MDT
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.57.2 Description

Le maître saisit, dans la liste de configuration des conteneurs de données MDT, les numéros IDN relatifs aux données d'exploitation à envoyer via les conteneurs de données MDT correspondants (A et B du conteneur de données standard, et A1 à A10 du conteneur de données étendu), si nécessaire entre le maître et l'esclave.

Les IDN de cette liste des IDN peuvent provenir de S-0-0445 Liste des IDN de données configurables dans le conteneur de données MDT ou de S-0-0188 Liste des IDN de données configurables en tant que consommateur, en l'absence de S-0-0445.

A.3.58 IDN S-0-0495 Liste de configuration de conteneurs A7 de données MDT

A.3.58.1 Attributs

Le Tableau A.73 présente les attributs potentiels pour cet IDN.

Tableau A.73 – Attributs de l'IDN S-0-0495

Attribut	Valeur
Nom	Liste de configuration de conteneurs A7 de données MDT
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.58.2 Description

Le maître saisit, dans la liste de configuration des conteneurs de données MDT, les numéros IDN relatifs aux données d'exploitation à envoyer via les conteneurs de données MDT

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correspondants (A et B du conteneur de données standard, et A1 à A10 du conteneur de données étendu), si nécessaire entre le maître et l'esclave.

Les IDN de cette liste des IDN peuvent provenir de S-0-0445 Liste des IDN de données configurables dans le conteneur de données MDT ou de S-0-0188 Liste des IDN de données configurables en tant que consommateur, en l'absence de S-0-0445.

A.3.59 IDN S-0-0496 Liste de configuration de conteneurs A8 de données MDT

A.3.59.1 Attributs

Le Tableau A.74 présente les attributs potentiels pour cet IDN.

Tableau A.74 – Attributs de l'IDN S-0-0496

Attribut	Valeur
Nom	Liste de configuration de conteneurs A8 de données MDT
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.59.2 Description

Le maître saisit, dans la liste de configuration des conteneurs de données MDT, les numéros IDN relatifs aux données d'exploitation à envoyer via les conteneurs de données MDT correspondants (A et B du conteneur de données standard, et A1 à A10 du conteneur de données étendu), si nécessaire entre le maître et l'esclave.

Les IDN de cette liste des IDN peuvent provenir de S-0-0445 Liste des IDN de données configurables dans le conteneur de données MDT ou de S-0-0188 Liste des IDN de données configurables en tant que consommateur, en l'absence de S-0-0445.

A.3.60 IDN S-0-0497 Liste de configuration de conteneurs A9 de données MDT

A.3.60.1 Attributs

Le Tableau A.75 présente les attributs potentiels pour cet IDN.

Tableau A.75 – Attributs de l'IDN S-0-0497

Attribut	Valeur
Nom	Liste de configuration de conteneurs A9 de données MDT
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—

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Attribut	Valeur
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.60.2 Description

Le maître saisit, dans la liste de configuration des conteneurs de données MDT, les numéros IDN relatifs aux données d'exploitation à envoyer via les conteneurs de données MDT correspondants (A et B du conteneur de données standard, et A1 à A10 du conteneur de données étendu), si nécessaire entre le maître et l'esclave.

Les IDN de cette liste des IDN peuvent provenir de S-0-0445 Liste des IDN de données configurables dans le conteneur de données MDT ou de S-0-0188 Liste des IDN de données configurables en tant que consommateur, en l'absence de S-0-0445.

A.3.61 IDN S-0-0498 Liste de configuration de conteneurs A10 de données MDT

A.3.61.1 Attributs

Le Tableau A.76 présente les attributs potentiels pour cet IDN.

Tableau A.76 – Attributs de l'IDN S-0-0498

Attribut	Valeur
Nom	Liste de configuration de conteneurs A10 de données MDT
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.61.2 Description

Le maître saisit, dans la liste de configuration des conteneurs de données MDT, les numéros IDN relatifs aux données d'exploitation à envoyer via les conteneurs de données MDT correspondants (A et B du conteneur de données standard, et A1 à A10 du conteneur de données étendu), si nécessaire entre le maître et l'esclave.

Les IDN de cette liste des IDN peuvent provenir de S-0-0445 Liste des IDN de données configurables dans le conteneur de données MDT ou de S-0-0188 Liste des IDN de données configurables en tant que consommateur, en l'absence de S-0-0445.

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A.3.62 IDN S-0-0500 Liste de configuration de conteneurs A2 de données AT

A.3.62.1 Attributs

Le Tableau A.77 présente les attributs potentiels pour cet IDN.

Tableau A.77 – Attributs de l'IDN S-0-0500

Attribut	Valeur
Nom	Liste de configuration de conteneurs A2 de données AT
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.62.2 Description

Le maître saisit, dans la liste de configuration des conteneurs de données AT, les numéros IDN relatifs aux données d'exploitation à envoyer via les conteneurs de données AT correspondants (A et B du conteneur de données standard, et A1 à A10 du conteneur de données étendu), si nécessaire entre l'esclave et le maître.

Les IDN de cette liste des IDN peuvent provenir de S-0-0444 ou de S-0-0187, en l'absence de S-0-0444.

A.3.63 IDN S-0-0501 Liste de configuration de conteneurs A3 de données AT

A.3.63.1 Attributs

Le Tableau A.78 présente les attributs potentiels pour cet IDN.

Tableau A.78 – Attributs de l'IDN S-0-0501

Attribut	Valeur
Nom	Liste de configuration de conteneurs A3 de données AT
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

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A.3.63.2 Description

Le maître saisit, dans la liste de configuration des conteneurs de données AT, les numéros IDN relatifs aux données d'exploitation à envoyer via les conteneurs de données AT correspondants (A et B du conteneur de données standard, et A1 à A10 du conteneur de données étendu), si nécessaire entre l'esclave et le maître.

Les IDN de cette liste des IDN peuvent provenir de S-0-0444 ou de S-0-0187, en l'absence de S-0-0444.

A.3.64 IDN S-0-0502 Liste de configuration de conteneurs A4 de données AT

A.3.64.1 Attributs

Le Tableau A.79 présente les attributs potentiels pour cet IDN.

Tableau A.79 – Attributs de l'IDN S-0-0502

Attribut	Valeur
Nom	Liste de configuration de conteneurs A4 de données AT
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.64.2 Description

Le maître saisit, dans la liste de configuration des conteneurs de données AT, les numéros IDN relatifs aux données d'exploitation à envoyer via les conteneurs de données AT correspondants (A et B du conteneur de données standard, et A1 à A10 du conteneur de données étendu), si nécessaire entre l'esclave et le maître.

Les IDN de cette liste des IDN peuvent provenir de S-0-0444 ou de S-0-0187, en l'absence de S-0-0444.

A.3.65 IDN S-0-0503 Liste de configuration de conteneurs A5 de données AT

A.3.65.1 Attributs

Le Tableau A.80 présente les attributs potentiels pour cet IDN.

Tableau A.80 – Attributs de l'IDN S-0-0503

Attribut	Valeur
Nom	Liste de configuration de conteneurs A5 de données AT
Version	—
Longueur	4, variable

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Attribut	Valeur
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.65.2 Description

Le maître saisit, dans la liste de configuration des conteneurs de données AT, les numéros IDN relatifs aux données d'exploitation à envoyer via les conteneurs de données AT correspondants (A et B du conteneur de données standard, et A1 à A10 du conteneur de données étendu), si nécessaire entre l'esclave et le maître.

Les IDN de cette liste des IDN peuvent provenir de S-0-0444 ou de S-0-0187, en l'absence de S-0-0444.

A.3.66 IDN S-0-0504 Liste de configuration de conteneurs A6 de données AT

A.3.66.1 Attributs

Le Tableau A.81 présente les attributs potentiels pour cet IDN.

Tableau A.81 – Attributs de l'IDN S-0-0504

Attribut	Valeur
Nom	Liste de configuration de conteneurs A6 de données AT
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.66.2 Description

Le maître saisit, dans la liste de configuration des conteneurs de données AT, les numéros IDN relatifs aux données d'exploitation à envoyer via les conteneurs de données AT correspondants (A et B du conteneur de données standard, et A1 à A10 du conteneur de données étendu), si nécessaire entre l'esclave et le maître.

Les IDN de cette liste des IDN peuvent provenir de S-0-0444 ou de S-0-0187, en l'absence de S-0-0444.

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A.3.67 IDN S-0-0505 Liste de configuration de conteneurs A7 de données AT

A.3.67.1 Attributs

Le Tableau A.82 présente les attributs potentiels pour cet IDN.

Tableau A.82 – Attributs de l'IDN S-0-0505

Attribut	Valeur
Nom	Liste de configuration de conteneurs A7 de données AT
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.67.2 Description

Le maître saisit, dans la liste de configuration des conteneurs de données AT, les numéros IDN relatifs aux données d'exploitation à envoyer via les conteneurs de données AT correspondants (A et B du conteneur de données standard, et A1 à A10 du conteneur de données étendu), si nécessaire entre l'esclave et le maître.

Les IDN de cette liste des IDN peuvent provenir de S-0-0444 ou de S-0-0187, en l'absence de S-0-0444.

A.3.68 IDN S-0-0506 Liste de configuration de conteneurs A8 de données AT

A.3.68.1 Attributs

Le Tableau A.83 présente les attributs potentiels pour cet IDN.

Tableau A.83 – Attributs de l'IDN S-0-0506

Attribut	Valeur
Nom	Liste de configuration de conteneurs A8 de données AT
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

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A.3.68.2 Description

Le maître saisit, dans la liste de configuration des conteneurs de données AT, les numéros IDN relatifs aux données d'exploitation à envoyer via les conteneurs de données AT correspondants (A et B du conteneur de données standard, et A1 à A10 du conteneur de données étendu), si nécessaire entre l'esclave et le maître.

Les IDN de cette liste des IDN peuvent provenir de S-0-0444 ou de S-0-0187, en l'absence de S-0-0444.

A.3.69 IDN S-0-0507 Liste de configuration de conteneurs A9 de données AT

A.3.69.1 Attributs

Le Tableau A.84 présente les attributs potentiels pour cet IDN.

Tableau A.84 – Attributs de l'IDN S-0-0507

Attribut	Valeur
Nom	Liste de configuration de conteneurs A9 de données AT
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.69.2 Description

Le maître saisit, dans la liste de configuration des conteneurs de données AT, les numéros IDN relatifs aux données d'exploitation à envoyer via les conteneurs de données AT correspondants (A et B du conteneur de données standard, et A1 à A10 du conteneur de données étendu), si nécessaire entre l'esclave et le maître.

Les IDN de cette liste des IDN peuvent provenir de S-0-0444 ou de S-0-0187, en l'absence de S-0-0444.

A.3.70 IDN S-0-0508 Liste de configuration de conteneurs A10 de données AT

A.3.70.1 Attributs

Le Tableau A.85 présente les attributs potentiels pour cet IDN.

Tableau A.85 – Attributs de l'IDN S-0-0508

Attribut	Valeur
Nom	Liste de configuration de conteneurs A10 de données AT
Version	—
Longueur	4, variable

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Attribut	Valeur
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.70.2 Description

Le maître saisit, dans la liste de configuration des conteneurs de données AT, les numéros IDN relatifs aux données d'exploitation à envoyer via les conteneurs de données AT correspondants (A et B du conteneur de données standard, et A1 à A10 du conteneur de données étendu), si nécessaire entre l'esclave et le maître.

Les IDN de cette liste des IDN peuvent provenir de S-0-0444 ou de S-0-0187, en l'absence de S-0-0444.

A.3.71 IDN S-0-1000.0.1 Classes SCP actives

A.3.71.1 Attributs

Le Tableau A.86 présente les attributs potentiels pour cet IDN.

Tableau A.86 – Attributs de l'IDN S-0-1000.0.1

Attribut	Valeur
Nom	Classes SCP actives
Version	—
Longueur	2, variable
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.71.2 Description

Le maître programme le paramètre IDN S-0-1000.0.1 avec les classes de l'IDN S-0-1000.0.0 pour lesquelles l'esclave connaît les classes qui sont nécessaires pour l'application. Ce paramètre peut contenir uniquement les classes également proposées dans l'IDN S-0-1000.0.0 par l'esclave. Chaque classe doit être unique dans l'IDN S-0-1000.0.1. Ce paramètre est accessible en écriture en phase CP2 uniquement. Par conséquent, l'esclave peut optimiser les ressources des fonctions de communication en phase CP3.

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A.3.72 IDN S-0-1000 Type & Version SCP

A.3.72.1 Attributs

Le Tableau A.87 présente les attributs potentiels pour cet IDN.

Tableau A.87 – Attributs de l'IDN S-0-1000

Attribut	Valeur
Nom	Type & Version SCP
Version	—
Longueur	2, variable
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.72.2 Description

L'IDN Type & Version SCP (voir Tableau A.88) contient une liste de toutes les classes de communication de Type 19 avec la version dédiée prise en charge par l'esclave. La prise en charge d'une version de classe implique également automatiquement la prise en charge de toutes les versions inférieures de cette classe. Néanmoins, un esclave doit signifier toutes les versions des classes mises en œuvre comme éléments séparés. L'ordre des éléments dans cette liste n'est pas défini.

Les bits 15 ... 8 indiquent la classe SCP disponible dans l'appareil esclave, les bits 7 ... 4 sont réservés, et les bits 3 ... 0 indiquent la version de la classe SCP.

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Tableau A.88 – Type et version SCP

Code de classe Bits 15-8	Bits 7-4 réservés	Version Bits 3-0	Nom de la classe	Défini dans la version de Type 19	Description
0x01	0x0	0x1	SCP_FixCFG	V1.1.1	Configuration fixe des connexions
0x01	0x0	0x2	SCP_FixCFG_0x02	V1.3	Configuration fixe des connexions
0x01	0x0	0x3	SCP_FixCFG_0x03	V1.3	Configuration fixe des connexions & arrêt des connexions
0x02	0x0	0x1	SCP_VarCFG	V1.1.1	Configuration variable des connexions homogènes
0x02	0x0	0x2	SCP_VarCFG_0x02	V1.3	Configuration variable des connexions homogènes
0x02	0x0	0x3	SCP_VarCFG_0x03	V1.3	Configuration variable des connexions homogènes & arrêt des connexions
0x03	0x0	0x1	SCP_Sync	V1.1.1	Synchronisation
0x03	0x0	0x2	SCP_Sync_0x02	V1.3	Synchronisation tSync > tScyc en utilisant le champ étendu MDT
0x03	0x0	0x3	SCP_Sync_0x03	V1.3	Synchronisation tSync > tScyc en utilisant le champ étendu MDT
0x04	0x0	0x1	SCP_WD	V1.1.1	Chien de garde de connexion
0x04	0x0	0x2	SCP_WD_0x02	V1.3	Chien de garde de connexion avec temporisation & pertes de données
0x05	0x0	0x1	SCP_Diag	V1.1.1	Diagnostics de communication
0x06	0x0	0x1	SCP_RTB	V1.1.1	Configuration de bits en temps réel
0x07	0x0	0x1	SCP_HP	V1.1.1	Connexion à chaud
0x08	0x0	0x1	SCP_SMP	V1.1.1	SMP
0x09	0x0	0x1	SCP_MuX	V1.1.1	Canal multiplex (conteneur de données standard)
0x0A	0x0	0x1	SCP_NRT	V1.1.1	-
0x0B	0x0	0x1	SCP_Sig	V1.1.1	Mot de bits en temps réel en tant que producteur et consommateur
0x0C	0x0	0x1	SCP_ListSeg	V1.3	transfert de listes segmentées via la SVC
0x0D	0x0	0x1	SCP_IPS	V1.3	Prise en charge de services de protocole Internet IPS au moyen du canal UC
0x0E	0xn	0xn	réservé		pour des extensions futures
0x0F	0x0	0x1	SCP_Cap	V1.3	Capacités de connexion
0x10	0x0	0x1	SCP_ExtMuX	V1.1.2	Canal multiplex étendu (conteneur de données étendu)
0x11	0x0	0x1	SCP_RTBListProd	V1.3	Liste de bits en temps réel en tant que producteur (état)
0x12	0x0	0x1	SCP_RTBListCons	V1.3	Liste de bits en temps réel en tant que consommateur (commande)
0x13	0x0	0x1	SCP_SysTime	V1.3	définir le temps de Type 19

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Code de classe Bits 15-8	Bits 7-4 réservés	Version Bits 3-0	Nom de la classe	Défini dans la version de Type 19	Description
					en utilisant le champ étendu MDT
0x14	0x0	0x1	SCP_RTBWordProd	V1.3	Mot de bits en temps réel en tant que producteur
0x15	0x0	0x1	SCP_RTBWordCons	V1.3	Mot de bits en temps réel en tant que consommateur
0x16	0x0	0x1	SCP_SafetyCon	V1.3	Connexion CSoS
0x17	0x0	0x1	SCP_OvSBasic	V1.3	Mot de bits en temps réel en tant que consommateur
0x18	0x0	0x1	SCP_NRTPC	V1.3	Canal UC (communication IP)
0x19	0x0	0x1	SCP_Cyc	V1.3	transmission cyclique
0x03	0x0	0x1	SCP_Sync	V1.1.1	Synchronisation
0x03	0x0	0x2	SCP_Sync_0x02	V1.3	Synchronisation tSync > tScyc en utilisant le champ étendu MDT
0x03	0x0	0x3	SCP_Sync_0x03	V1.3	Synchronisation tSync > tScyc en utilisant le champ étendu MDT
0x04	0x0	0x1	SCP_WD	V1.1.1	Chien de garde de connexion
0x04	0x0	0x2	SCP_WD_0x02	V1.3	Chien de garde de connexion avec temporisation & pertes de données
0x05	0x0	0x1	SCP_Diag	V1.1.1	Diagnostics de communication
0x06	0x0	0x1	SCP_RTB	V1.1.1	Configuration de bits en temps réel
0x07	0x0	0x1	SCP_HP	V1.1.1	Connexion à chaud
0x08	0x0	0x1	SCP_SMP	V1.1.1	SMP
0x09	0x0	0x1	SCP_MuX	V1.1.1	Canal multiplex (conteneur de données standard)
0x0A	0x0	0x1	SCP_NRT	V1.1.1	-
0x0B	0x0	0x1	SCP_Sig	V1.1.1	Mot de bits en temps réel en tant que producteur et consommateur
0x0C	0x0	0x1	SCP_ListSeg	V1.3	transfert de listes segmentées via la SVC
0x0D	0x0	0x1	SCP_IPS	V1.3	Prise en charge de services de protocole Internet IPS au moyen du canal UC
0x0E	0xn	0xn	réservé		pour des extensions futures
0x0F	0x0	0x1	SCP_Cap	V1.3	Capacités de connexion
0x10	0x0	0x1	SCP_ExtMuX	V1.1.2	Canal multiplex étendu (conteneur de données étendu)
0x11	0x0	0x1	SCP_RTBListProd	V1.3	Liste de bits en temps réel en tant que producteur (état)
0x12	0x0	0x1	SCP_RTBListCons	V1.3	Liste de bits en temps réel en tant que consommateur (commande)
0x13	0x0	0x1	SCP_SysTime	V1.3	définir le temps de Type 19 en utilisant le champ étendu MDT
0x14	0x0	0x1	SCP_RTBWordProd	V1.3	Mot de bits en temps réel en

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Code de classe Bits 15-8	Bits 7-4 réservés	Version Bits 3-0	Nom de la classe	Défini dans la version de Type 19	Description
					tant que producteur
0x15	0x0	0x1	SCP_RTBWordCons	V1.3	Mot de bits en temps réel en tant que consommateur
0x16	0x0	0x1	SCP_SafetyCon	V1.3	Connexion CSoS
0x17	0x0	0x1	SCP_OvSBasic	V1.3	Mot de bits en temps réel en tant que consommateur
0x18	0x0	0x1	SCP_NRTPC	V1.3	Canal UC (communication IP)
0x19	0x0	0x1	SCP_Cyc	V1.3	transmission cyclique

A.3.73 IDN S-0-1002 Durée de cycle de communication

A.3.73.1 Attributs

Le Tableau A.89 présente les attributs potentiels pour cet IDN.

Tableau A.89 – Attributs de l'IDN S-0-1002

Attribut	Valeur
Nom	Durée de cycle de communication (tScyc)
Version	—
Longueur	4
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	31 250 (31,250 µs)
Valeur d'entrée maximale	65 000 000 (65000,000 µs)
Positions après la décimale	3
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	0,001 µs
Unité	µs

A.3.73.2 Description

La durée de cycle de communication (tScyc) définit les intervalles au cours desquels les MDT et AT configurés doivent être transférés par le maître à tous les esclaves présents. Les durées de cycle de communication sont définies sous la forme 31,25 µs, 62,5 µs, 125 µs, 250 µs ou tout nombre entier multiple de 250 µs, jusqu'à 65 ms. En phase CP2, il est nécessaire que tScyc soit transférée du maître à l'esclave et soit activée par le maître et l'esclave en CP3 et CP4.

Les valeurs min/max sont obligatoires et doivent être adoptées par le constructeur. Les valeurs min/max doivent être les valeurs possibles en théorie.

A.3.74 IDN S-0-1003 Pertes MST admises en CP3/CP4

A.3.74.1 Attributs

Le Tableau A.90 présente les attributs potentiels pour cet IDN.

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Tableau A.90 – Attributs de l'IDN S-0-1003

Attribut	Valeur
Nom	Pertes MST admises en CP3/CP4
Version	—
Longueur	4
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.74.2 Description

Ce paramètre définit le nombre maximal de cycles de communication successifs au cours desquels un esclave peut ne pas recevoir le télégramme MST en phases CP3 et CP4. L'esclave doit recommuter de la phase CP3 ou CP4 sur le mode NRT lorsqu'il n'a pas reçu son télégramme MST selon un nombre supérieur à celui défini par l'utilisateur et

- règle le numéro de diagnostic S-0-0390 sur 0xC30F4001 et
- règle l'erreur (S-DEV.Bit7) dans son Etat d'appareil (S-DEV) ou S-0-1045

Avec moins de 50 % des données d'exploitation de ce paramètre, l'esclave doit

- réinitialiser l'avertissement de communication (S-DEV.Bit15) dans son état d'appareil et
- réinitialiser l'avertissement (S-DEV.Bit6) dans son Etat d'appareil (S-DEV) ou S-0-1045

Au-delà de 50 % des données d'exploitation de ce paramètre, l'esclave doit

- régler le numéro de diagnostic S-0-0390 sur 0xC30E4001
- définir l'avertissement de communication (S-DEV.Bit15) dans son état d'appareil et
- faire clignoter la DEL de Type 19 entre la couleur rouge et verte au moins pendant 2 secondes, ou tant que l'avertissement de communication (S-DEV.Bit15) est présent et
- définir l'avertissement (S-DEV.Bit6) dans son Etat d'appareil (S-DEV) ou S-0-1045

Ce paramètre doit également être réglé sur une valeur suffisamment grande (par comparaison avec S-0-1050.x.11 Pertes de données admises), de sorte que le maître peut continuer à communiquer avec des sous-appareils non perturbés en vue de l'arrêt en toute sécurité des autres parties de la machine.

Par exemple:

- S-0-1003 = 5 -> L'avertissement est défini avec 3 pertes de télégrammes. L'erreur est définie avec 6 pertes de télégrammes.
- S-0-1003 = 4 -> L'avertissement est défini avec 3 pertes de télégrammes. L'erreur est définie avec 5 pertes de télégrammes.

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A.3.75 IDN S-0-1005 Temps minimal de traitement de contrôle par retour (t_5)

A.3.75.1 Attributs

Le Tableau A.91 présente les attributs potentiels pour cet IDN.

Tableau A.91 – Attributs de l'IDN S-0-1005

Attribut	Valeur
Nom	Temps minimal de traitement de contrôle par retour (t_5)
Version	—
Longueur	4
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	3
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	0,001 µs
Unité	µs

A.3.75.2 Description

t_5 spécifie la durée maximale spécifique à l'esclave qui lui est nécessaire entre la saisie de ses données du producteur (par exemple, valeurs de retour) et leur mise à disposition pour transmission dans les télégrammes AT.

Si l'IDN S-0-1060 (Capacités de connexion) est disponible, t_5 couvre la valeur maximale de l'IDN S-0-1060.x.07 (Temps maximal de traitement) pour toutes les instances du producteur de l'IDN S-0-1060.

A.3.76 IDN S-0-1006 Temps de début de transmission d'AT (t_1)

A.3.76.1 Attributs

Le Tableau A.92 présente les attributs potentiels pour cet IDN.

Tableau A.92 – Attributs de l'IDN S-0-1006

Attribut	Valeur
Nom	Temps de début de transmission d'AT (t_1)
Version	—
Longueur	4
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	3
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	0,001 µs
Unité	µs

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A.3.76.2 Description

Le temps de début de transmission de AT0 (t1) détermine l'intervalle de temps nominal entre la fin de MST et le début de AT0. Le maître envoie son AT0 sur la base du télégramme MST en CP3 et CP4. Ce paramètre doit être transféré par le maître à l'esclave en phase CP2.

Le temps maximal de début de transmission doit être inférieur à tScyc.

A.3.77 IDN S-0-1007 Temps de synchronisation (Tsync)

A.3.77.1 Attributs

Le Tableau A.93 présente les attributs potentiels pour cet IDN.

Tableau A.93 – Attributs de l'IDN S-0-1007

Attribut	Valeur
Nom	Temps de synchronisation (Tsync)
Version	—
Longueur	4
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	0
Valeur d'entrée maximale	—
Positions après la décimale	3
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	0,001 μs
Unité	0 μs

A.3.77.2 Description

Le temps de synchronisation (TSync) définit le moment auquel toutes les durées de cycle du producteur (connexions de production et de consommation) dans un esclave sont synchronisées. Le maître doit définir un temps de synchronisation inférieur à la durée de cycle de synchronisation (tsync-cycle). Cette durée constitue le plus petit commun multiple de toutes les durées de cycle du producteur (tPcyc) qui doivent être synchronisées dans un réseau.

Dans chaque cycle de communication, le point de référence de synchronisation (Tsref) est généré par les MST. L'un de ces temps TSref est choisi avec TSref-Counter = 0 (TSref0). Le temps de synchronisation (Tsync) définit le décalage entre le temps TSref0 et TSync pour le cycle de synchronisation (tsync-cycle).

Tous les cycles du producteur (tPcyc) dans l'esclave sont synchronisés au temps TSync. Les temps de synchronisation suivants sont définis par les durées de cycle du producteur correspondantes. Les temps de synchronisation des connexions sont étiquetés T4Cx afin de les différencier. Cela signifie que le temps de synchronisation (T4) du cycle du producteur (PC), avec l'index de structure (x) de la connexion (x = 0 ... 255).

Le sous-appareil doit activer le temps de synchronisation lors de la phase CP3.

La Figure A.4 présente un exemple de délai de synchronisation avec différents cycles du producteur.

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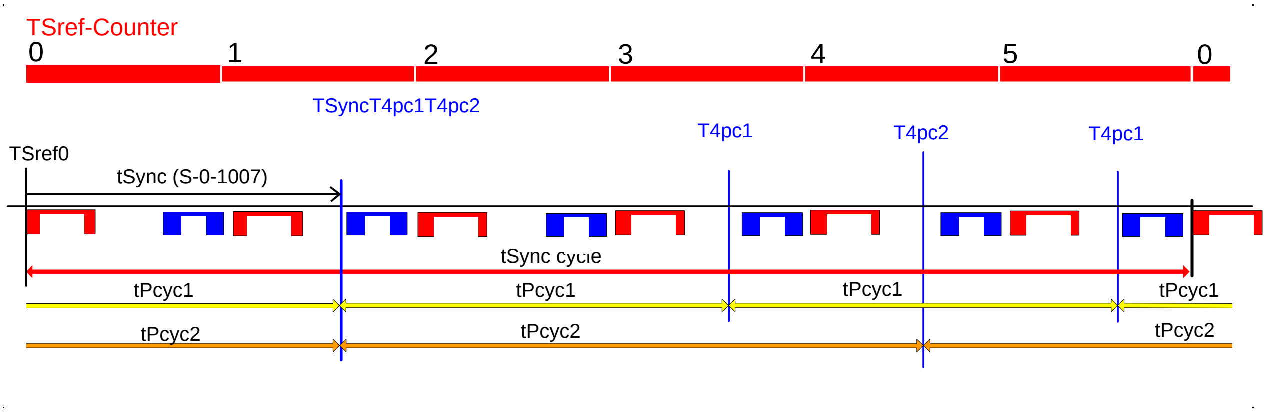

Figure A.4 – Exemple de délai de synchronisation avec différents cycles du producteur

A.3.78 IDN S-0-1008 Période de validité de la valeur de commande (t_3)

A.3.78.1 Attributs

Le Tableau A.94 présente les attributs potentiels pour cet IDN.

Tableau A.94 – Attributs de l'IDN S-0-1008

Attribut	Valeur
Nom	Période de validité de la valeur de commande (t_3)
Version	—
Longueur	4
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	0
Valeur d'entrée maximale	TScyc
Positions après la décimale	3
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	0,001 µs
Unité	µs

A.3.78.2 Description

La période de validité de la valeur de commande indique la période au terme de laquelle l'esclave peut accéder aux nouvelles valeurs provenant du MDT et associées au temps de synchronisation. Ainsi, le maître peut prédéfinir la même période de validité de la valeur de commande pour toutes les applications coordonnées.

A.3.79 IDN S-0-1009 Décalage de la commande d'appareil (C-DEV) dans le télégramme MDT

A.3.79.1 Attributs

Le Tableau A.95 présente les attributs potentiels pour cet IDN.

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Tableau A.95 – Attributs de l'IDN S-0-1009

Attribut	Valeur
Nom	Décalage de la commande d'appareil (C-DEV) dans le télégramme MDT
Version	—
Longueur	2
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.79.2 Description

Le décalage de commande d’appareil dans le MDT définit le nombre de MDT et la position dans ce télégramme MDT pour la commande d'appareil. Ce paramètre doit être transféré par le maître à chaque esclave en phase CP2. Il doit devenir actif en phase CP3 aussi bien dans le maître que dans l'esclave. Ce décalage doit débuter après l'en-tête de Type 19 dans le MDT. Le décalage de la commande d'appareil doit correspondre à un nombre pair.

Le Tableau A.96 présente la structure de cet IDN.

Tableau A.96 – Décalage C-DEV dans le télégramme MDT

Numéro de bit	Valeur de bit	Description
15-14	00	réservé
13-12	—	Numéro de télégramme MDT
	00	MDT0
	01	MDT1
	10	MDT2
	11	MDT3
11-0	—	Décalage dans le MDT (en octets)
	0..1492	Le décalage C-DEV dans le MDT (doit être un nombre pair)

A.3.80 IDN S-0-1010 Longueurs des télégrammes MDT

A.3.80.1 Attributs

Le Tableau A.97 présente les attributs potentiels pour cet IDN.

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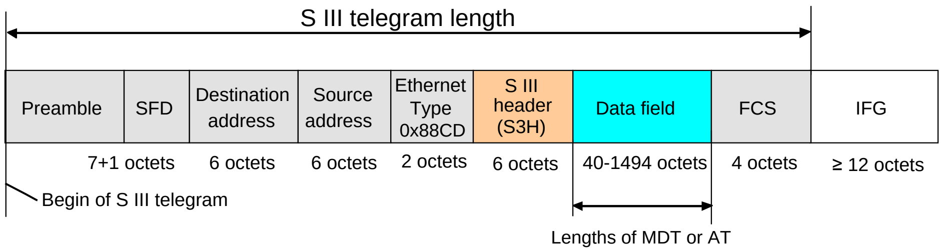
Tableau A.97 – Attributs de l'IDN S-0-1010

Attribut	Valeur
Nom	Longueurs des télégrammes MDT
Version	—
Longueur	2, variable
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.80.2 Description

Les longueurs des télégrammes MDT doivent correspondre à un nombre pair et sont exprimées en octets (voir Figure A.5). Le paramètre doit contenir les longueurs des quatre télégrammes de données maître potentiels. Les longueurs sont nécessaires pour l'initialisation du matériel de communication de Type 19. Il faut que les quatre longueurs soient toujours spécifiées. Les MDT non configurés doivent être marqués avec la longueur = 0 et le maître ne doit pas les transmettre. Chaque esclave doit être informé des longueurs de tous les télégrammes MDT configurés, par le maître en phase CP2. Il doit devenir actif dans le maître et les autres esclaves en phase CP3.

La longueur inclut toutes les données comprises entre la fin de l'en-tête de Type 19 et le début de la FCS.



Légende

Anglais	Français
S III telegram length	Longueur de télégramme S III
Preamble	Préambule
Destination address	Adresse de destination
Source address	Adresse source
Ethernet type	Ethernet type
S III header	En-tête S III
Data field	Champ de données
Begin of S S III telegram	Début de télégramme S III
Lengths of MDT or AT	Longueurs de MDT ou AT

Figure A.5 – Définition de la longueur MDT

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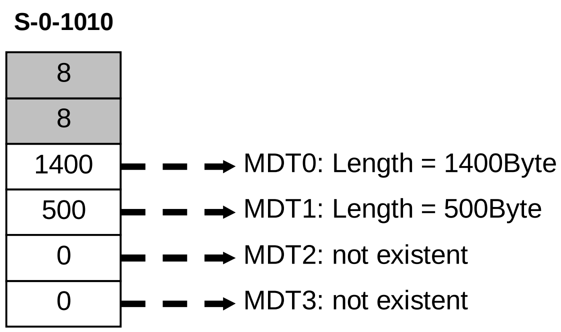
Le maître doit régler les longueurs de tout MDT configuré dans la plage 40 ≤ longueur MDT ≤ 1494. A défaut, l'esclave génère le message d'erreur 0x7008 dans la SVC.

Le nombre d'éléments de liste de ce paramètre est fixé à quatre.

La Figure A.6 présente la structure de cet IDN à titre d'exemple.



Légende

Anglais	Français
Length = 1400 Byte	Longueur = 1400 octets
Length = 500 Byte	Longueur = 500 octets
Not existent	Non existant

Figure A.6 – Longueurs des télégrammes MDT (exemple)

A.3.81 IDN S-0-1011 Décalage de l'état d'appareil (S-DEV) dans le télégramme AT

A.3.81.1 Attributs

Le Tableau A.98 présente les attributs potentiels pour cet IDN.

Tableau A.98 – Attributs de l'IDN S-0-1011

Attribut	Valeur
Nom	Décalage de l'état d'appareil (S-DEV) dans le télégramme AT
Version	—
Longueur	2
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.81.2 Description

Le décalage de l'état d'appareil dans le télégramme AT définit la position du champ de l'état d'appareil de l'esclave dans l'un des télégrammes AT existants, ladite position étant exprimée

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en tant que position OCTET. Le décalage doit débuter après l'en-tête de Type 19 dans l'AT. Ce paramètre doit être transféré par le maître à chaque esclave en phase CP2. Il doit devenir actif en phase CP3 aussi bien dans le maître que dans l'esclave. Le décalage de l'état d'appareil doit correspondre à un nombre pair.

Le Tableau A.99 présente la structure de cet IDN.

Tableau A.99 – Décalage S-DEV dans le télégramme AT

Numéro de bit	Valeur de bit	Description
15-14	—	(réservé)
13-12	—	Numéro de télégramme AT
	00	AT0
	01	AT1
	10	AT2
	11	AT3
11-0	—	Décalage S-DEV dans l'AT (en octets)
	0..1492	Le décalage S-DEV dans l'AT (doit être un nombre pair)

A.3.82 IDN S-0-1012 Longueurs des télégrammes AT

A.3.82.1 Attributs

Le Tableau A.100 présente les attributs potentiels pour cet IDN.

Tableau A.100 – Attributs de l'IDN S-0-1012

Attribut	Valeur
Nom	Longueurs des télégrammes AT
Version	—
Longueur	2, variable
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.82.2 Description

Les longueurs des télégrammes AT doivent correspondre à un nombre pair et sont exprimées en octets (voir Figure A.7). Le paramètre doit contenir les longueurs des quatre télégrammes AT potentiels. Les longueurs sont nécessaires pour l'initialisation du matériel de Type 19. Il faut que les quatre longueurs soient toujours spécifiées. Les AT non configurés doivent être marqués avec la longueur = 0 et le maître ne doit pas les transmettre. Chaque esclave doit être informé des longueurs de tous les télégrammes AT configurés, par le maître en phase CP2. Il doit devenir actif dans le maître et l'esclave en phase CP3. La longueur inclut toutes les données comprises entre la fin de l'en-tête AT et le début de la FCS. Le nombre d'éléments de liste de ce paramètre est fixé à quatre.

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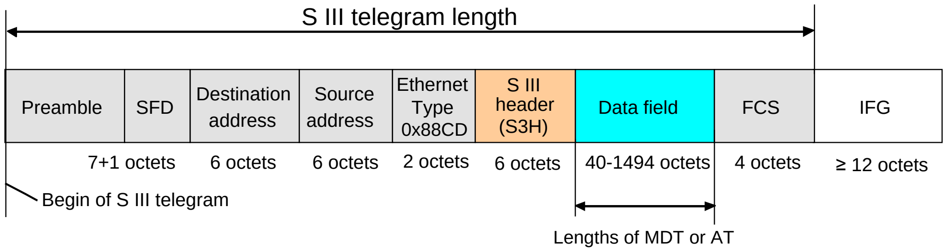
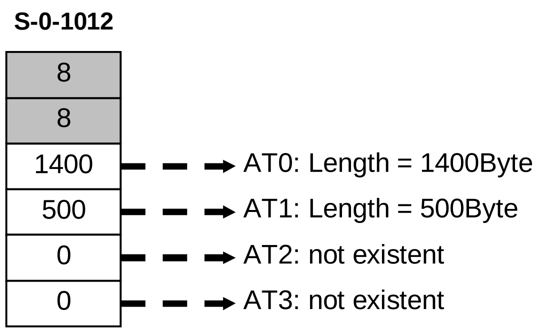


Légende

Anglais	Français
S III telegram length	Longueur de télégramme S III
Preamble	Préambule
Destination address	Adresse de destination
Source address	Adresse source
Ethernet type	Ethernet type
S III header	En-tête S III
Data field	Champ de données
Begin of S III telegram	Début de télégramme S III
Lengths of MDT or AT	Longueurs de MDT ou AT

Figure A.7 – Définition de la longueur AT

La Figure A.8 présente la structure de cet IDN à titre d'exemple.



Légende

Anglais	Français
Length = 1400 Byte	Longueur = 1400 octets
Length = 500 Byte	Longueur = 500 octets
Not existent	Non existant

Figure A.8 – Longueurs des télégrammes AT (exemple)

A.3.83 IDN S-0-1013 Décalage SVC dans le télégramme MDT

A.3.83.1 Attributs

Le Tableau A.101 présente les attributs potentiels pour cet IDN.

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Tableau A.101 – Attributs de l'IDN S-0-1013

Attribut	Valeur
Nom	Décalage SVC dans le télégramme MDT
Version	—
Longueur	2
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.83.2 Description

Le décalage SVC dans le MDT définit la position de la voie de service pour l'esclave. Ce décalage doit débuter après l'en-tête de Type 19 dans le MDT associé. Chaque esclave doit être informé du décalage de la voie de service dans le télégramme MDT, par le maître en phase CP2. Ce paramètre doit devenir actif en phase CP3 aussi bien dans le maître que dans l'esclave. Le décalage SVC doit correspondre à un nombre pair.

Le Tableau A.102 présente la structure de cet IDN.

Tableau A.102 – Décalage SVC dans le télégramme MDT

Numéro de bit	Valeur de bit	Description
15-14	—	(réservé)
	0	Aucune autre valeur admise
13-12	—	Numéro de télégramme MDT
	00	MDT0
	01	MDT1
	10	MDT2
	11	(réservé)
11-0	—	Décalage SVC MDT (en octets)
	0 … 1484	Le décalage SVC MDT (doit correspondre à un nombre pair)

A.3.84 IDN S-0-1014 Décalage SVC dans le télégramme AT

A.3.84.1 Attributs

Le Tableau A.103 présente les attributs potentiels pour cet IDN.

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Tableau A.103 – Attributs de l'IDN S-0-1014

Attribut	Valeur
Nom	Décalage SVC dans le télégramme AT
Version	—
Longueur	2
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.84.2 Description

Le décalage SVC dans l'AT définit la position d'une voie de service pour l'esclave. Le décalage doit débuter après l'en-tête de Type 19 dans l'AT associé. Chaque esclave doit être informé du décalage de la voie de service dans le télégramme AT, par le maître en phase CP2. Ce paramètre doit devenir actif en phase CP3 aussi bien dans le maître que dans l'esclave. Le décalage SVC doit correspondre à un nombre pair.

Le Tableau A.104 présente la structure de cet IDN.

Tableau A.104 – Décalage SVC dans le télégramme AT

Numéro de bit	Valeur de bit	Description
15-14	—	(réservé)
	0	Aucune autre valeur admise
13-12	—	Numéro de télégramme AT
	00	AT0
	01	AT1
	10	AT2
	11	AT3
11-0	—	Décalage SVC AT (en octets)
	0 … 1484	Le décalage SVC AT (doit correspondre à un nombre pair)

A.3.85 IDN S-0-1015 Retard de l'anneau

A.3.85.1 Attributs

Le Tableau A.105 présente les attributs potentiels pour cet IDN.

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Tableau A.105 – Attributs de l'IDN S-0-1015

Attribut	Valeur
Nom	Retard de l'anneau
Version	—
Longueur	4
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	1048,575
Positions après la décimale	3
Protection en écriture	Jamais
Facteur de conversion	1
Mise à l'échelle/résolution	0,001 µs
Unité	µs

A.3.85.2 Description

Le maître détermine le retard de l'anneau complet et l'affecte aux esclaves. Le retard de l'anneau est nécessaire aux esclaves pour qu'ils suppriment la durée de la transmission et déterminent leur temps de référence de synchronisation (TSref).

Le maître calcule le retard de l'anneau pour une topologie linéaire ou en anneau donnée, à l'aide de la formule suivante:

S-0-1015 Retard de l'anneau = tRing + instabilité IFG + retard supplémentaire

Après chaque mise sous tension, ce paramètre contient différentes valeurs. Par conséquent, cet IDN ne doit pas faire partie de l'IDN S-0-0327.x.0 (Liste des IDN du paramètre de somme de contrôle).

A.3.86 IDN S-0-1016 Retard de l'esclave (P/S)

A.3.86.1 Attributs

Le Tableau A.106 présente les attributs potentiels pour cet IDN.

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Tableau A.106 – Attributs de l'IDN S-0-1016

Attribut	Valeur
Nom	Retard de l'esclave (P/S)
Version	—
Longueur	4, variable
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	0
Valeur d'entrée maximale	—
Positions après la décimale	3
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	0,001 µs
Unité	µs

A.3.86.2 Description

Après avoir attribué S-0-1015 Retard de l'anneau à l'esclave, le maître détermine SYNCCNT-P et SYNCCNT-S, au moment de l'exécution de S-0-1024 Commande de procédure de mesure de retard SYNC.

Dans la topologie en anneau, les deux éléments de liste doivent être remplis avec les valeurs mesurées.

Dans la topologie linéaire:

- la plus grande valeur mesurée est saisie dans l'élément de liste correspondant,
- la plus faible valeur mesurée est rejetée et l'élément de liste non utilisé est réglé sur zéro.

Eléments de liste:

- L'élément de liste 0 est SYNCCNT-P
- L'élément de liste 1 est SYNCCNT-S

A.3.87 IDN S-0-1017 Durée de transmission du canal UC

A.3.87.1 Attributs

Le Tableau A.107 présente les attributs potentiels pour cet IDN.

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Tableau A.107 – Attributs de l'IDN S-0-1017

Attribut	Valeur
Nom	Durée de transmission du canal UC
Version	—
Longueur	4, variable
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	3
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	0,001 µs
Unité	µs

A.3.87.2 Description

La durée de transmission NRT inclut deux éléments de liste (t6 & t7).

- Premier élément de liste t6 (début du canal UC)
  - T6 définit la durée requise par l'esclave pour commuter la topologie du canal RT au canal UC.
  - Lorsque le canal UC n'est pas requis, le maître doit régler t6 sur 0.
  - Lorsque le canal UC est requis, le maître doit régler t6 comme cela est spécifié dans l'article "Accès au support".
- Second élément de liste t7 (fin du canal UC)
  - T7 définit la durée requise par l'esclave pour commuter la topologie du canal UC au canal RT.
  - Lorsque le canal UC n'est pas requis, la durée t7 est "sans importance" (don't care).
  - Lorsque le canal UC est requis, le maître doit régler t7 comme cela est spécifié dans l'article "Accès au support".

Si la longueur du canal UC est inférieure à 125µs, S-0-1027.0.1 MTU demandée doit être ajusté en conséquence.

Les limites de t6 & t7 sont décrites en 7.1.2.

A.3.88 IDN S-0-1019 Adresse MAC

A.3.88.1 Attributs

Le Tableau A.108 présente les attributs potentiels pour cet IDN.

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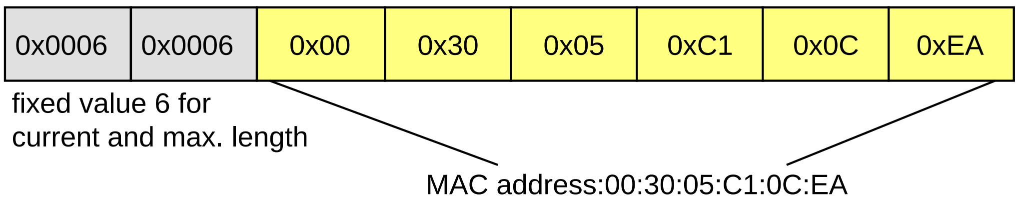
Tableau A.108 – Attributs de l'IDN S-0-1019

Attribut	Valeur
Nom	Adresse MAC
Version	—
Longueur	1, variable
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.88.2 Description

L'esclave intègre son adresse MAC dans ce paramètre.

La Figure A.9 présente la structure de cet IDN.



Légende

Anglais	Français
Fixed value 6 for current and max. length	Valeur fixe de 6 pour la longueur actuelle et la longueur maximale
MAC address	Adresse MAC

Figure A.9 – Structure de l'adresse MAC

A.3.89 IDN S-0-1020.0.1 Adresse IP actuelle

A.3.89.1 Attributs

Le Tableau A.109 présente les attributs potentiels pour cet IDN.

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Tableau A.109 – Attributs de l'IDN S-0-1020.0.1

Attribut	Valeur
Nom	Adresse IP actuelle
Version	—
Longueur	1, variable
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.89.2 Description

Cet IDN contient l'adresse IP actuelle de l'interface de communication de Type 19 de l'esclave. Le maître peut modifier l'adresse IP par la saisie de l'IDN S-0-1020 (Adresse IP) et l'exécution de la commande de procédure IDN S-0-1048 (Activer les paramètres réseau).

La Figure A.10 présente la structure de cet IDN.

A.3.90 IDN S-0-1020 Adresse IPu

A.3.90.1 Attributs

Le Tableau A.110 présente les attributs potentiels pour cet IDN.

Tableau A.110 – Attributs de l'IDN S-0-1020

Attribut	Valeur
Nom	Adresse IP
Version	—
Longueur	1, variable
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Jamais
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.90.2 Description

Pour SCP_NRT: Cet IDN contient l'adresse IP de l'interface de communication de Type 19 de l'esclave. Le maître peut modifier l'adresse IP par la saisie de cet IDN.

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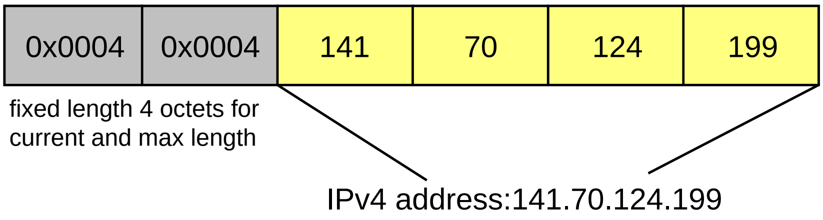
Pour SCP_NRTPC: Cet IDN contient l'adresse IP demandée de l'interface de communication de Type 19 de l'esclave. Le maître peut modifier l'adresse IP par la saisie de cet IDN et l'exécution de la commande de procédure IDN S-0-1048 (Activer les paramètres réseau) afin de l'activer. L'adresse IP actuelle est affichée dans l'IDN S-0-1020.0.1 (Adresse IP actuelle).

La Figure A.10 présente la structure de cet IDN.



Légende

Anglais	Français
Fixed length 4 octets for current and max. length	longueur fixe de 4 octets pour la longueur actuelle et la longueur maximale
Ipv4 address	Adresse Ipv4

Figure A.10 – Structure de l'adresse IP

A.3.91 IDN S-0-1021.0.1 Masque de sous-réseau actuel

A.3.91.1 Attributs

Le Tableau A.111 présente les attributs potentiels pour cet IDN.

Tableau A.111 – Attributs de l'IDN S-0-1021.0.1

Attribut	Valeur
Nom	Masque de sous-réseau actuel
Version	—
Longueur	1, variable
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.91.2 Description

Cet IDN contient le masque de sous-réseau actuellement activé de l'interface de communication de Type 19 de l'esclave. Le maître peut modifier le masque de sous-réseau par la saisie de l'IDN S-0-1021.0.0 et l'exécution de la commande de procédure S-0-1048 conformément à A.3.113.

La structure de cet IDN figure dans le Tableau A.112.

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A.3.92 IDN S-0-1021 Masque de sous-réseau

A.3.92.1 Attributs

Le Tableau A.112 présente les attributs potentiels pour cet IDN.

Tableau A.112 – Attributs de l'IDN S-0-1021

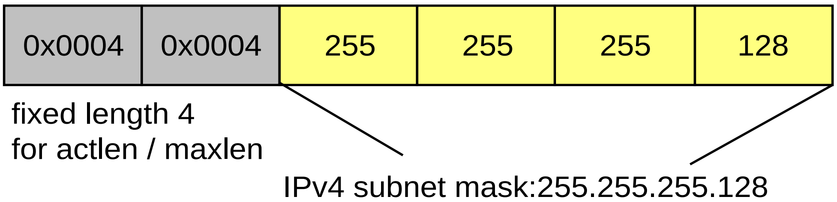
Attribut	Valeur
Nom	Masque de sous-réseau
Version	—
Longueur	1, variable
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.92.2 Description

Pour SCP_NRT: Cet IDN contient le masque de sous-réseau de l'interface de communication de Type 19 de l'esclave. Le maître peut modifier le masque de sous-réseau par la saisie de cet IDN.

Pour SCP_NRTPC: Cet IDN contient le masque de sous-réseau de l'interface de communication de Type 19 de l'esclave. Le maître peut modifier le masque de sous-réseau par la saisie de cet IDN et l'exécution de la commande de procédure S-0-1048 (Activer les paramètres réseau) afin de l'activer. Le masque de sous-réseau actuel est affiché dans l'IDN S-0-1020.0.1 (Adresse IP actuelle).

La Figure A.11 présente la structure de cet IDN.



Légende

Anglais	Français
Fixed length 4 octets for actlen/maxlen	longueur fixe de 4 pour la longueur actuelle et la longueur maximale
Ipv4 subnet mask	Masque de sous-réseau Ipv4

Figure A.11 – Structure du masque de sous-réseau

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A.3.93 IDN S-0-1022.0.1 Adresse de passerelle actuelle

A.3.93.1 Attributs

Le Tableau A.113 présente les attributs potentiels pour cet IDN.

Tableau A.113 – Attributs de l'IDN S-0-1022.0.1

Attribut	Valeur
Nom	Adresse de passerelle
Version	—
Longueur	1, variable
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.93.2 Description

Cet IDN contient l'adresse de passerelle actuellement active de l'interface de communication de Type 19 de l'esclave. Le maître peut modifier l'adresse de passerelle par la saisie de l'IDN S-0-1022.0.0 et l'exécution de la commande de procédure S-0-1048.

La Figure A.12 présente la structure de cet IDN.

A.3.94 IDN S-0-1022 Adresse de passerelle

A.3.94.1 Attributs

Le Tableau A.114 présente les attributs potentiels pour cet IDN.

Tableau A.114 – Attributs de l'IDN S-0-1022

Attribut	Valeur
Nom	Adresse de passerelle
Version	—
Longueur	1, variable
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

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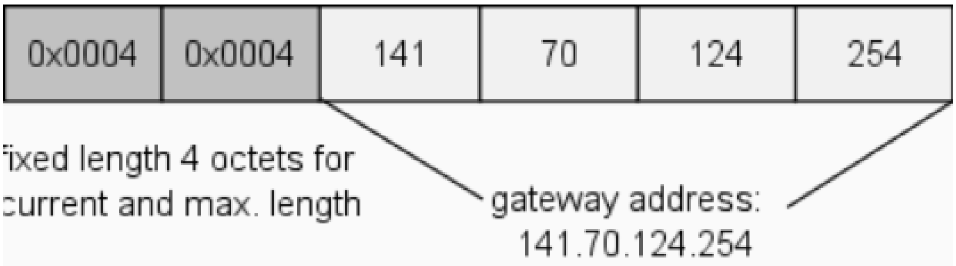
A.3.94.2 Description

Pour SCP_NRT: Cet IDN contient l'adresse de passerelle de l'interface de communication de Type 19 de l'esclave. Le maître peut modifier l'adresse de passerelle par la saisie de cet IDN.

Pour SCP_NRTPC: Cet IDN contient l'adresse de passerelle demandée de l'interface de communication de Type 19 de l'esclave. Le maître peut modifier l'adresse de passerelle par la saisie de cet IDN et l'exécution de la commande de procédure IDN S-0-1048 (Activer les paramètres réseau) afin de l'activer. L'adresse de passerelle actuelle est affichée dans l'IDN S-0-1020.0.1 (Adresse IP actuelle).

La Figure A.12 présente la structure de cet IDN.



Légende

Anglais	Français
Fixed length 4 octets for current and max. length	longueur fixe de 4 octets pour la longueur actuelle et la longueur maximale
Gateway address	Adresse de passerelle

Figure A.12 – Structure de l'adresse de passerelle

A.3.95 IDN S-0-1023 Instabilité SYNC

A.3.95.1 Attributs

Le Tableau A.115 présente les attributs potentiels pour cet IDN.

Tableau A.115 – Attributs de l'IDN S-0-1023

Attribut	Valeur
Nom	Instabilité SYNC
Version	—
Longueur	4
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	3
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	0,001 µs
Unité	µs

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A.3.95.2 Description

Le maître doit calculer l'instabilité de synchronisation maximale. L'esclave utilise cette instabilité pour déterminer la largeur de la fenêtre MST. Cette fenêtre équivaut à 2x l'instabilité de synchronisation. Le maître doit transmettre le paramètre IDN S-0-1023 à tous les esclaves prenant en charge SCP_Sync.

Le maître doit calculer l'instabilité de synchronisation maximale comme suit:

L'instabilité maximale des MST transmis (instabilité MST) dépend du matériel du maître. Le maître connaît l'instabilité MST.

L'instabilité maximale de l'espace entre trames (instabilité IFG) dépend du nombre de participants à la topologie. La formule suivante doit par conséquent être utilisée:

Formule de calcul de l'instabilité IFG:

$$\text{instabilité IFG} \geq \frac{27 * (S-0-1037)_{\text{MAX}} * \sqrt{2 * N}}{8000} [\mu s]$$

NOTE N est le nombre de participants à la topologie.

L'instabilité SYNC doit inclure l'instabilité MST et l'instabilité IFG, et doit par ailleurs être supérieure ou égale à l'écart de précision de l'oscillateur à quartz par rapport à la durée de cycle de communication (tScyc) ou S-0-1002.

Exemple:

- S-0-1002 = 10 ms;
- précision = 100 µHz/Hz;
- --> écart= 1 µs;
- l'instabilité Sync doit être supérieure ou égale à l'écart de 1 µs.

Formule de calcul de l'instabilité SYNC:

$$\text{instabilité SYNC} = \frac{\text{instabilité MST} + \text{instabilité IFG}}{2} \geq \frac{S-0-1002}{10000\,[100\text{ppm}]} [\mu s]$$

L'instabilité MST de ±40 ns doit être utilisée avec 80 ns dans le calcul de l'instabilité SYNC.

A.3.96 IDN S-0-1024 Commande de procédure de mesure de retard SYNC

A.3.96.1 Attributs

Le Tableau A.116 présente les attributs potentiels pour cet IDN.

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Tableau A.116 – Attributs de l'IDN S-0-1024

Attribut	Valeur
Nom	Commande de procédure de mesure de retard SYNC
Version	—
Longueur	2
Format d'affichage	Binaire
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.96.2 Description

Après activation de cette commande de procédure, l'esclave doit déterminer SYNCCNT-P et SYNCCNT-S (S-0-1016 Retard de l'esclave (P&S)) selon le retard de l'anneau (S-0-1015).

a) En phase CP2, l'acquittement positif est généré lorsque l'esclave a pu déterminer SYNCCNT-P et SYNCCNT-S comme valides. Dans ce cas, l'esclave effectue automatiquement une synchronisation en phase CP3 ou CP4.
b) En phase CP3 ou CP4, l'acquittement positif est généré lorsque l'esclave a pu déterminer SYNCCNT-P et SYNCCNT-S comme valides et a effectué une nouvelle synchronisation.

L'esclave génère un acquittement négatif et établit les diagnostics suivants:

a) S-0-1015 Retard de l'anneau est invalide (par exemple, valeur = 0) --> S-0-0390 Numéro de diagnostic est réglé sur le code de diagnostic 0xC30C5301.
b) SYNCCNT-P ou SYNCCNT-S est égal à 0, ou la mesure de SYNCCNT-P ou SYNCCNT-S a été interrompue ou perturbée --> S-0-0390 Numéro de diagnostic réglé sur le code de diagnostic 0xC30C5302.

Le maître doit activer cette commande de procédure

- et attendre la fin de son exécution en phase CP2 avant d'activer S-0-0127 Contrôle de transition CP3,
- en phases CP3 et CP4 après récupération de l'anneau

dans chaque esclave qu'il faut synchroniser.

A.3.97 IDN S-0-1026 Version du matériel de communication

A.3.97.1 Attributs

Le Tableau A.117 présente les attributs potentiels pour cet IDN.

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Tableau A.117 – Attributs de l'IDN S-0-1026

Attribut	Valeur
Nom	Version du matériel de communication
Version	—
Longueur	1, variable
Format d'affichage	Texte
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.97.2 Description

Ce paramètre inclut l'identification du matériel de communication de Type 19, par exemple, la version et la révision du matériel.

Exemple pour FPGA: SERCON100M V02.01

A.3.98 IDN S-0-1027.0.1 MTU demandée

A.3.98.1 Attributs

Le Tableau A.118 présente les attributs potentiels pour cet IDN.

Tableau A.118 – Attributs de l'IDN S-0-1027.0.1

Attribut	Valeur
Nom	MTU demandée
Version	—
Longueur	2
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	46
Valeur d'entrée maximale	1500
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.98.2 Description

La MTU demandée définit le nombre maximal d'octets qui peuvent être transmis dans le canal UC par des couches supérieures. Cet IDN définit uniquement la valeur cible de la MTU et permet de calculer la MTU effective ou S-0-1027.0.2. La valeur effective peut être différente de la valeur cible, si cette dernière dépasse les limites de la phase de communication actuelle.

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- Dans le cas de SCP_NRT, il est nécessaire que la MTU effective soit définie sur l'interface de Type 19 immédiatement et actualisée lorsque cet IDN est saisi ou en cas de changement de phase avéré.
- Dans le cas de SCP_NRTPC, il est nécessaire que la MTU effective soit recalculée et définie sur l'interface de Type 19 par l'exécution de la commande de procédure S-0-1048 (Activer paramètres réseau) ou en cas de changement de phase avéré.

Par exemple, si cet IDN est réglé sur 80, la MTU effective pendant les phases NRT, CP0, CP1, CP2 et HP0 est de 576 (voir Tableau A.119).

NOTE Ce paramètre peut servir à calculer la dernière durée de transmission du canal UC.

Lorsque le même anneau comporte des appareils V1.1.1 de Type 19, ainsi que des appareils de Type 19 de versions plus récentes, ce paramètre doit être réglé par le maître sur la valeur 1500 pour chaque appareil de Type 19 dont la version est plus récente que V.1.1.1 de Type 19.

Calcul de la MTU effective:

$tNRT = (t7 - t6) > 6{,}72\ \mu s$

$$MTU(tNRT) = \min\left\{1500; \frac{tNRT}{s} * 12.498.750 - 38\right\}$$

Tableau A.119 – Limite supérieure et limite inférieure de la MTU

Phase de communication (CP)	Limite supérieure (CP)	Limite inférieure (CP)
NRT	1500	**576**
CP0	1500	**576**
CP1	1500	**576**
CP2	1500	**576**
CP3	MTU(tNRT)	46
CP4	MTU(tNRT)	46
HP0	1500	**576**
HP1	MTU(tNRT)	46
HP2	MTU(tNRT)	46

$MTU_{interim} = \min \{upperlimit(cp); MTU_{requested}\}$

$MTU_{effective} = \max \{lowerlimit(cp); MTU_{interim}\}$

La valeur par défaut pour cet IDN doit être 1500.

A.3.99 IDN S-0-1027.0.2 MTU effective

A.3.99.1 Attributs

Le Tableau A.120 présente les attributs potentiels pour cet IDN.

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Tableau A.120 – Attributs de l'IDN S-0-1027.0.2

Attribut	Valeur
Nom	MTU effective
Version	—
Longueur	2
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	46
Valeur d'entrée maximale	1500
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.99.2 Description

Cet IDN correspond à la MTU actuelle. Les IDN S-0-1017 et IDN-0-1027.0.1 permettent de calculer la MTU actuelle. Pour de plus amples informations, voir l'IDN S-0-1027.0.1.

A.3.100 IDN S-0-1028 Compteur d'erreurs MST-P/S

A.3.100.1 Attributs

Le Tableau A.121 présente les attributs potentiels pour cet IDN.

Tableau A.121 – Attributs de l'IDN S-0-1028

Attribut	Valeur
Nom	Compteur d'erreurs MST-P/S
Version	—
Longueur	2
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.100.2 Description

Le compteur d'erreurs MST est incrémenté de un lorsqu'un télégramme MST valide n'est reçu ni sur le port 1, ni sur le port 2 dans la fenêtre MST spécifiée (voir S-0-1023 Instabilité SYNC dans les phases de communication 3 et 4).

Le compteur d'erreurs doit arrêter tout comptage dès qu'il atteint la valeur 65 535. Cela signifie que si la valeur du compteur est 65 535, il peut exister plus de 65 535 télégrammes MST invalides (par exemple, transmission bruitée sur une longue période de temps).

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Ce compteur doit être réinitialisé par l'esclave, si le maître commute de CP2 sur CP3.

A.3.101 IDN S-0-1031 Port 1 & Port 2 d'attribution de broches d'essai

A.3.101.1 Attributs

Le Tableau A.122 présente les attributs potentiels pour cet IDN.

Tableau A.122 – Attributs de l'IDN S-0-1031

Attribut	Valeur
Nom	Port 1 & Port 2 d'attribution de broches d'essai
Version	—
Longueur	2
Format d'affichage	Binaire
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.101.2 Description

Ce paramètre permet d'attribuer les signaux de matériel de communication aux broches d'essai TS1 et TS2 (voir Tableau A.123). Le signal attribué est mappé avec les broches d'essai TS1 ou TS2.

Tableau A.123 – Structure du port 1 & port 2 d'attribution de broches d'essai

Numéro de bit	Valeur	Description
15-12		(réservé)
11-8		Le signal choisi est mappé avec la broche d'essai TS2 (les signaux à choisir sont présentés dans le tableau suivant).
7-4		(réservé)
3-0		Le signal choisi est mappé avec la broche d'essai TS1 (les signaux à choisir sont présentés dans le tableau suivant).

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Tableau A.124 – Signaux de sortie à choisir

Valeur	Signal esclave	Description
0000	Port 1 MST	**Impulsion MST de MAC Rx du port 1 (durée de 40 ns)**
0001	Port 2 MST	Impulsion MST de MAC Rx du port 2 (durée de 40 ns)
0010	TMST	Signal TMST après générateur MST (TSref)
0011	CON_CLK	Horloge CON du temporisateur TCNT
0100	DIV_CLK	Horloge DIV de l'unité d'horloge DIV (uniquement si présente)
0101	Recharge TCNT	Dépassement de capacité du temporisateur TCNT
0110	Recharge TCNT port 1	Dépassement de capacité du temporisateur de port 1
0111	Recharge TCNT port 2	Dépassement de capacité du temporisateur de port 2
1000	Ouverture IP port 1	Fenêtre IP port 1
1001	Ouverture en écriture IP port 1	Fenêtre de transmission IP port 1
1010	Ouverture IP port 2	Fenêtre IP port 2
1011	Ouverture en écriture IP port 2	Fenêtre de transmission IP port 2
1100	Ouverture fenêtre MST port 1	Fenêtre MST port 1
1101	Ouverture fenêtre MST port 2	Fenêtre MST port 2
1110	Trame Rx port 1	Réception d'une trame sur le port 1
1111	Trame Rx port 2	Réception d'une trame sur le port 2

A.3.102 IDN S-0-1034 Compteur d'erreurs PHY Port 1 & Port 2

A.3.102.1 Attributs

Le Tableau A.125 présente les attributs potentiels pour cet IDN.

Tableau A.125 – Attributs de l'IDN S-0-1035

Attribut	Valeur
Nom	Compteur d'erreurs PHY Port 1 & Port 2
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Jamais
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.102.2 Description

Ces compteurs d'erreurs contrôlent les éléments PHY Ethernet pour les impulsions d'erreur.

Le mot de niveau bas représente le compteur d'erreurs du port 1 et le mot de niveau haut représente le compteur d'erreurs du port 2.

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En raison de la seule fréquence prise en charge de 25 MHz (100 Mbits) d'un réseau de Type 19, la valeur de ces compteurs représente le nombre de périodes d'horloge de 40 ns avec l'indication "Porteuse fausse" ("False Carrier") ou "Réception de données avec erreurs" ("Data reception with errors") de l'élément PHY sur l'interface MII.

Cet IDN est accessible en écriture, de sorte qu'une interface homme-machine peut réinitialiser ces compteurs d'erreurs. La valeur maximale pour chaque compteur est 0xFFFF. Les compteurs d'erreurs ne sont pas mis en mémoire tampon et doivent être réglés sur 0 à la mise sous tension.

Le Tableau A.126 est extrait des normes IEEE 802.3 et ISO/CEI 8802-3 afin de présenter le codage des erreurs PHY.

Tableau A.126 – Codage des erreurs PHY

RX_DV	RX_ER	RXD<3:0>	Indication
1	1	0000 à 1111	Réception des données avec erreurs
0	1	1110	Indication "fausse porteuse"
0	1	0000	Espace entre trames normal
0	1	0001 à 1101	(réservé)
0	1	1111	(réservé)

A.3.103 IDN S-0-1035 Compteur d'erreurs Port 1 & Port 2

A.3.103.1 Attributs

Le Tableau A.127 présente les attributs potentiels pour cet IDN.

Tableau A.127 – Attributs de l'IDN S-0-1035

Attribut	Valeur
Nom	Compteur d'erreurs Port 1 & Port 2
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Jamais
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.103.2 Description

Ces compteurs d'erreurs contrôlent les télégrammes MAC. Ces derniers sont des télégrammes de Type 19, ainsi que des télégrammes Ethernet.

Le mot de niveau bas représente le compteur d'erreurs du port 1 et le mot de niveau haut représente le compteur d'erreurs du port 2.

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Le compteur doit se déclencher en phase CP0, son incrémentation s'effectuant au maximum par palier de un par cycle de communication, si un télégramme MAC invalide est détecté. Les compteurs d'erreurs sont accessibles en écriture, de sorte qu'une interface homme-machine peut réinitialiser ces compteurs d'erreurs. La valeur maximale pour chaque compteur est 0xFFFF. Les compteurs d'erreurs ne sont pas mis en mémoire tampon et doivent être réglés sur 0 à la mise sous tension.

Télégramme invalide: Le contenu des télégrammes MAC invalides ne doit pas être transmis aux sous-couches. L'occurrence de télégrammes MAC invalides peut être communiquée à la gestion de réseau. Les télégrammes MAC invalides peuvent être ignorés ou rejetés;

Un télégramme invalide doit être défini comme un télégramme satisfaisant au moins à l'une des conditions suivantes:

- Erreur d'alignement: Il ne s'agit pas d'un nombre entier d'octets en longueur.
- Erreur FCS: Les bits du télégramme entrant (à l'exception du champ FCS proprement dit) ne génèrent pas une valeur FCS identique à celle reçue.
- Erreur CRC: Les bits du télégramme entrant (à l'exception du champ CRC proprement dit de l'en-tête de Type 19) ne génèrent pas une valeur CRC identique à celle reçue.
- Erreur de longueur de télégramme de Type 19: Le télégramme n'a pas été reçu avec la longueur prévue.

Les télégrammes MAC sont vérifiés de différentes manières. Cette vérification est spécifiée tel que présenté dans le Tableau A.128.

Tableau A.128 – Vérification des télégrammes MAC

Télégrammes MAC	FCS	CRC	Alignement	Longueur
Télégrammes Ethernet	Oui	Non	Oui	Non
Télégrammes de type 19	Oui	Oui	Oui	Oui

A.3.104 IDN S-0-1036 Espace entre trames

A.3.104.1 Attributs

Le Tableau A.129 présente les attributs potentiels pour cet IDN.

Tableau A.129 – Attributs de l'IDN S-0-1036

Attribut	Valeur
Nom	Espace entre trames
Version	—
Longueur	2
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	12
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	Octets

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A.3.104.2 Description

Un temps de récupération succinct entre les trames permet aux appareils de préparer la réception de la trame suivante. Le réseau Ethernet spécifie l'espace entre trames minimal avec 96 bits (12 octets), qui constitue une durée de 960 ns avec une vitesse de transmission de 100 Mbit/s.

L'espace entre trames dépend de l'instabilité de l'esclave (S-0-1037) et du nombre de participants (N) à la topologie. L'instabilité de l'esclave est définie dans le paramètre S-0-1037 "Instabilité de l'esclave" et doit être lue par le maître de chaque esclave. Lorsque ce paramètre n'est pas pris en charge par l'esclave, le maître doit utiliser une valeur par défaut de 80 ns. Seule la plus grande valeur de tous les IDN S-0-1037 doit être utilisée pour le calcul IFG.

Le maître doit utiliser la formule de l'IFG pour calculer l'espace entre trames pour l'application donnée.

Formule de calcul de l'instabilité IFG:

$$S-0-1036 \geq \frac{27 * S-0-1037_{MAX} * \sqrt{2 * N}}{8000} * \frac{1\,\text{octet}}{0{,}08\,\mu s} + 12\,\text{octets}$$

Le maître doit transmettre cet espace entre trames derrière chaque télégramme de Type 19 transmis.

Lorsque le maître ne transfère ce paramètre au cours de la phase CP2, l'esclave doit, dans ce cas, utiliser la valeur par défaut de 37 octets.

L'esclave doit utiliser cet espace entre trames pour son calcul de temporisation de télégramme de Type 19.

La formule de tIFG et de l'instabilité IFG doit calculer l'espace entre trames comme durée pour l'application donnée.

Formule de calcul de tIFG:

$$tIFG \geq \frac{27 * S-0-1037_{MAX} * \sqrt{2 * N}}{8000} + 0{,}96\,\mu s$$

Formule de calcul de l'instabilité IFG:

$$IFG\ jitter \geq tIFG - 0{,}96\,\mu s$$

A.3.105 IDN S-0-1037 Instabilité de l'esclave

A.3.105.1 Attributs

Le Tableau A.130 présente les attributs potentiels pour cet IDN.

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Tableau A.130 – Attributs de l'IDN S-0-1037

Attribut	Valeur
Nom	Instabilité de l'esclave
Version	—
Longueur	2
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	160
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	Octets

A.3.105.2 Description

L'interface génère une instabilité de télégramme qui dépend de la mis en œuvre du matériel. L'esclave doit indiquer son instabilité dans ce paramètre. Le maître doit utiliser ce paramètre pour déterminer l'espace entre trames pour la transmission. Il faut que la valeur de ce paramètre soit spécifiée par le constructeur.

Une instabilité de ± 40 ns doit être indiquée avec une durée de 80 ns dans ce paramètre.

A.3.106 IDN S-0-1039.0.1 Nom d'hôte actif actuel

A.3.106.1 Attributs

Le Tableau A.131 présente les attributs potentiels pour cet IDN.

Tableau A.131 – Attributs de l'IDN S-0-1039.0.1

Attribut	Valeur
Nom	Nom d'hôte actif actuel
Version	—
Longueur	1, variable
Format d'affichage	Texte
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.106.2 Description

Ce paramètre affiche le nom d'hôte de réseau actif actuel de cet appareil. Le maître peut modifier le nom d'hôte par la saisie de l'IDN S-0-1039.0.0 et l'exécution de la commande de procédure S-0-1048, afin de l'activer. L'appareil doit utiliser ce paramètre dans une demande DHCP afin d'identifier la fonctionnalité des nœuds de manière à attribuer l'adresse IP.

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Ce paramètre doit réserver au minimum un texte de 16 octets.

A.3.107 IDN S-0-1039 Nom d'hôte

A.3.107.1 Attributs

Le Tableau A.132 présente les attributs potentiels pour cet IDN.

Tableau A.132 – Attributs de l'IDN S-0-1039

Attribut	Valeur
Nom	Nom d'hôte
Version	—
Longueur	1, variable
Format d'affichage	Texte
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Jamais
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.107.2 Description

Ce paramètre présente le nom d'hôte de réseau de cet appareil. L'appareil doit utiliser ce paramètre dans une demande DHCP afin d'identifier la fonctionnalité des nœuds de manière à attribuer l'adresse IP. Le contenu de S-0-1039 (Nom d'hôte) doit être rémanent. Ce paramètre doit réserver au minimum un texte de 16 octets.

A.3.108 IDN S-0-1040 Adresse de sous-appareil

A.3.108.1 Attributs

Le Tableau A.133 présente les attributs potentiels pour cet IDN.

Tableau A.133 – Attributs de l'IDN S-0-1040

Attribut	Valeur
Nom	Adresse de sous-appareil
Version	—
Longueur	2
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	0
Valeur d'entrée maximale	511
Positions après la décimale	0
Protection en écriture	Spécifique au constructeur
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

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A.3.108.2 Description

Ce paramètre doit contenir l'adresse de sous-appareil d'un esclave.

L'adresse peut être définie via la voie de service ou par le biais d'un commutateur d'adresse (par exemple, commutateur DIP).

Définition de l'adresse de sous-appareil via la SVC

- L'appareil doit appliquer l'adresse de sous-appareil immédiatement après l'accès en écriture SVC.
- Le contenu de S-0-1040 doit être archivé de manière rémanente.

Définition de l'adresse de sous-appareil par le biais d'un commutateur d'adresse

- L'appareil doit toujours appliquer l'adresse de sous-appareil, qui apparaît sur le commutateur d'adresse.

Ces valeurs doivent être affichées immédiatement.

Lorsqu'un appareil prend en charge les deux méthodes de configuration d'adresse, il doit avoir le comportement suivant:

- Si le commutateur d'adresse indique une adresse qui n'est pas nulle.
  - L'appareil applique l'adresse qui apparaît sur le commutateur d'adresse.
  - S-0-1040 est protégé en écriture
- Si le commutateur d'adresse indique l'adresse 0
  - l'adresse de sous-appareil ne peut être configurée que par le biais de la SVC.
  - S-0-1040 n'est pas protégé en écriture

Les valeurs min/max sont obligatoires et doivent être adoptées par le constructeur.

A.3.109 IDN S-0-1041 Temps de validation de la valeur de commande AT (t9)

A.3.109.1 Attributs

Le Tableau A.134 présente les attributs potentiels pour cet IDN.

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Tableau A.134 – Attributs de l'IDN S-0-1041

Attribut	Valeur
Nom	Temps de validation de la valeur de commande AT (t9)
Version	—
Longueur	4
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	0
Valeur d'entrée maximale	tScyc
Positions après la décimale	3
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	0,001 µs
Unité	µs

A.3.109.2 Description

Après le temps de validation de la valeur de commande (t9), l'esclave peut accéder aux nouvelles valeurs de commandes de l'AT. Ainsi, le maître peut prédéfinir la même période de validité de la valeur de commande AT (t9) pour toutes les applications coordonnées.

A.3.110 IDN S-0-1044 Commande d'appareil (C-DEV)

A.3.110.1 Attributs

Le Tableau A.135 présente les attributs potentiels pour cet IDN.

Tableau A.135 – Attributs de l'IDN S-0-1044

Attribut	Valeur
Nom	Commande d'appareil
Version	—
Longueur	2
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.110.2 Description

La commande d'appareil contient l'information de commande (par exemple, contrôle de topologie) définie par le maître et évaluée par l'esclave (voir Tableau A.136). La commande d'appareil ne fait pas partie intégrante d'une connexion.

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Tableau A.136 – Champ de commande d'appareil (C-DEV)

Numéro de bit	Valeur de bit	Description
15	—	Identification
	0	Pas de demande d'identification
	1	Demande d'identification (l'esclave présente l'état de ce bit au niveau de la DEL de Type 19 ou à l'affichage). Cette fonction est utilisée pour l'attribution d'adresse distante ou pour les erreurs de configuration entre le maître et l'esclave.
14	—	Topologie HS (la valeur initiale est nulle dans chaque CP)
	commutation	Le maître bascule à chaque fois qu'il requiert un changement de topologie.
13-12	—	Contrôle de topologie (le maître choisit la nouvelle topologie)
	00	Acheminement rapide sur les deux ports
	01	Bouclage avec acheminement de télégrammes P
	10	Bouclage avec acheminement de télégrammes S
	11	(réservé : l'esclave doit ignorer cette combinaison de bits)
11	—	Topologie physique de contrôle (si l'esclave détecte une commutation, il doit alors abandonner la table d'adresses source. La topologie physique de contrôle est utilisée dans le canal UC uniquement)
	0	rupture de l'anneau physique
	1	fermeture de l'anneau physique
10-9	—	(réservé)
8	—	Maître valide (indique si le maître traite des données. En phase CP1, l'esclave détecte la prise en charge de cette fonction si ce bit est réglé sur 1 par le maître)
	0	Maître non valide (Le contenu de Commande d'appareil C-DEV est invalide. L'état "Producteur prêt" de toutes les connexions du producteur doit être réglé sur 0)
	1	Maître valide (Le contenu de Commande d'appareil C-DEV est valide)
7-0	—	(réservé)

A.3.111 IDN S-0-1045 Etat d'appareil

A.3.111.1 Attributs

Le Tableau A.137 présente les attributs potentiels pour cet IDN.

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Tableau A.137 – Attributs de l'IDN S-0-1045

Attribut	Valeur
Nom	Etat d'appareil
Version	—
Longueur	2
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.111.2 Description

L'état d'appareil (voir Tableau A.138) contient l'information d'état (par exemple, état de topologie) définie par l'esclave et évaluée par le maître. L'état d'appareil ne fait pas partie intégrante d'une connexion.

Le temps de réaction le plus rapide à tout événement qui affecte l'état d'appareil, à l'exception des bits 11-10 (état de port inactif), doit se situer dans la durée de cycle de production la plus lente, et être au plus de 200 ms.

Tableau A.138 – Champ d'état d'appareil

Numéro de bit	Valeur de bit	Description
15	—	Interface d'avertissement de communication
	0	Pas d'avertissement
	1	Avertissement de communication effectif (par exemple, le nombre de pertes MST admises a dépassé la demi-valeur de S-0-1003
14	—	Topologie HS
	commutation	La valeur initiale est nulle dans chaque CP. L'esclave commute si la demande du maître a été reconnue, ce qui signifie que l'état de topologie peut être actualisé après la commutation.
13-10	—	Etat de topologie /port
	0000	Acheminement rapide sur les deux ports (diagnostic non disponible)
	0100	Bouclage avec acheminement de télégrammes P (pas de liaison sur le port inactif --> pas d'appareil connecté)
	01-01	Bouclage avec acheminement de télégrammes P (LIAISON sur le port inactif --> appareil connecté)
	01-10	Bouclage avec acheminement de télégrammes P (LIAISON P: Télégrammes P sur le port inactif --> appareil de Type 19 connecté)
	01-11	Bouclage avec acheminement de télégrammes P (LIAISON S: Télégrammes S sur le port inactif --> appareil de Type 19 connecté)
	1000	Bouclage avec acheminement de télégrammes S (pas de liaison sur le port inactif --> pas d'appareil connecté)
	10-01	Bouclage avec acheminement de télégrammes S (LIAISON sur le port inactif --> appareil connecté)
	10-10	Bouclage avec acheminement de télégrammes S (LIAISON P: Télégrammes P sur le port inactif --> appareil de Type 19 connecté)

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Numéro de bit	Valeur de bit	Description
	10-11	Bouclage avec acheminement de télégrammes S (LIAISON S: Télégrammes S sur le port inactif --> appareil de Type 19 connecté)
	11-xx	archiver & acheminer ou transparent
	00-xx	Combinaisons de bits supplémentaires:
	00-01	acheminement rapide sur les deux ports (diagnostic pris en charge)
	00-10	acheminement rapide sur les deux ports (absence de télégrammes P)
	00-11	acheminement rapide sur les deux ports (absence de télégrammes S)
9	—	Connexion avec erreur
	0	Connexion sans erreur
	1	Erreur de connexion avérée (le consommateur a reconnu une erreur dans une connexion)
8	—	Esclave valide (indique si un esclave traite des données)
	0	Esclave non valide (Réglé sur 0 lorsqu'il entre dans la phase CP0. Modifié au cours de CPS. Le contenu de l'état d'appareil S-dev n'est pas valide. L'état "Producteur prêt" de toutes les connexions du producteur doit être réglé sur 0)
	1	Esclave valide (CP > CP0. Modifié au cours de CPS. Le contenu de l'état d'appareil (S-DEV) est valide)
7	—	Erreur (C1D), y compris les erreurs de sous-appareil et de ressources
	0	Pas d'erreur
	1	Erreur (les informations détaillées sont présentées dans S-0-0390)
6	—	Avertissement (C2D), y compris les avertissements de sous-appareil et de ressources
	0	Pas d'avertissement
	1	Avertissement (les informations détaillées sont présentées dans S-0-0390)
5	—	Bit de changement de commande de procédure
	0	Pas de changement dans l'acquittement de commande de procédure
	1	Changement dans l'acquittement de commande de procédure (acquittement positif ou négatif de la commande de procédure)
4	—	Niveau de sous-appareil
	0	Niveau de fonctionnement (OL) actif
	1	Niveau de paramétrage (PL) actif
3	—	(réservé)
2	—	(réservé)
1-0	—	(réservé)

A.3.112 IDN S-0-1047 Temps d'activation maximal du consommateur (t11)

A.3.112.1 Attributs

Le Tableau A.139 présente les attributs potentiels pour cet IDN.

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Tableau A.139 – Attributs de l'IDN S-0-1047

Attribut	Valeur
Nom	Temps d'activation maximal du consommateur (t11)
Version	—
Longueur	4
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	3
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	0,001 μs
Unité	—

A.3.112.2 Description

Le temps t11 spécifie la durée maximale spécifique à l'esclave, nécessaire entre la collecte des données du consommateur fournies par les télégrammes MDT et AT, et leur activation (par exemple, valeurs de commande) dans l'esclave.

Si l'IDN S-0-1060 Capacités de connexion est disponible, t11 couvre la valeur maximale de l'IDN S-0-1060.x.07 Temps maximal de traitement, pour toutes les instances du consommateur de l'IDN S-0-1060.

A.3.113 IDN S-0-1048 Activer les paramètres réseau

A.3.113.1 Attributs

Le Tableau A.140 présente les attributs potentiels pour cet IDN.

Tableau A.140 – Attributs de l'IDN S-0-1048

Attribut	Valeur
Nom	Activer les paramètres réseau
Version	—
Longueur	2
Format d'affichage	Binaire
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.113.2 Description

Cette commande de procédure permet d'activer les paramètres IP demandés de l'IDN suivant:

- Adresse IP ou S-0-1020.0.0
- Masque de sous-réseau ou S-0-1021.0.0

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- Adresse de passerelle ou S-0-1022.0.0
- S-0-1027.0.1

Les paramètres actifs peuvent être affichés dans l'IDN suivant:

- S-0-1020.0.1(facultatif)
- S-0-1021.0.1(facultatif)
- S-0-1022.0.1(facultatif)
- S-0-1027.0.2

A.3.114 IDN S-0-1046 Liste d'adresses d'appareils

A.3.114.1 Attributs

Le Tableau A.141 présente les attributs potentiels pour cet IDN.

Tableau A.141 – Attributs de l'IDN S-0-1046

Attribut	Valeur
Nom	Liste d'adresses d'appareils dans l'appareil
Version	—
Longueur	2, variable
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.114.2 Description

L'appareil à esclaves multiples archive les adresses de sous-appareil de ses esclaves qui participent à la communication (voir Figure A.13). Cet IDN peut être omis lorsque l'appareil ne comporte qu'un seul esclave.

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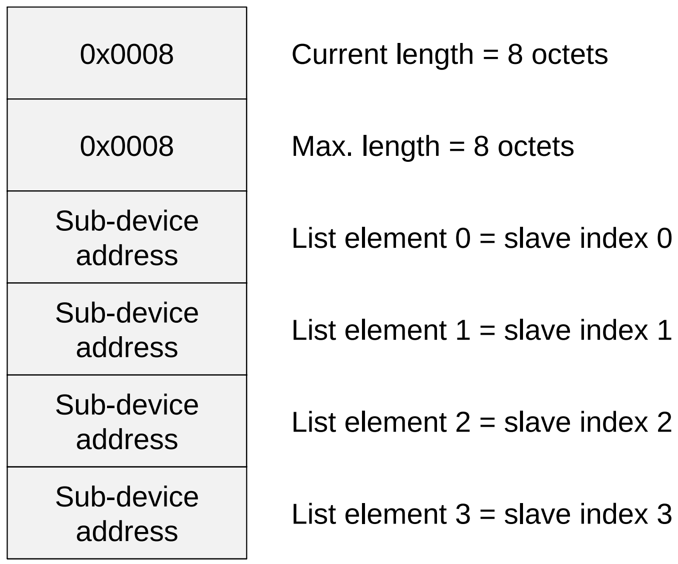

Légende

Anglais	Français
Current length	Longueur actuelle
Max. length	Longueur maximale
List element 0 = slave index 0	Elément de liste 0 = index d'esclave 0
List element 1 = slave index 1	Elément de liste 1 = index d'esclave 1
List element 2 = slave index 2	Elément de liste 2 = index d'esclave 2
List element 3 = slave index 3	Elément de liste 3 = index d'esclave 3
Sub-device address	Adresse de sous-appareil

Figure A.13 – Structure de liste des adresses de sous-appareil

A.3.115 IDN S-0-1050.x.1 Configuration de connexion

A.3.115.1 Attributs

Le Tableau A.142 présente les attributs potentiels pour cet IDN.

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Tableau A.142 – Attributs de l'IDN S-0-1050.x.1

Attribut	Valeur
Nom	Configuration de connexion
Version	—
Longueur	2
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.115.2 Description

Ce paramètre configure les connexions (voir Tableau A.143).

Tableau A.143 – Configuration de connexion

Numéro de bit	Valeur	Description
15	—	Application de connexion (voir note)
	0	Non utilisée (l'esclave ne doit pas utiliser cette connexion)
	1	Utilisée (l'esclave doit utiliser cette connexion)
14	—	fonction avec connexion (voir note)
	0	Consommateur
	1	Producteur
13-12	—	Source de configuration de connexion (voir note)
	00	Maître (configuré par le maître)
	01	(réservé)
	10	Externe (non configuré par le maître)
	11	(réservé)
11-6	—	(réservé)
5-4	—	type de configuration (voir note)
	00	configuration variable des IDN avec S-0-1050.x.06
	01	configuration avec longueur de connexion, voir S-0-1050.x.05. S-0-1050.x.06 n'est pas pris en compte dans le cas de FSP E/S: L'attribution de connexion est définie comme suit: (C-CON - Contrôle ES - S-0-1500.x.05) (C-CON - Etat ES - S-0-1500.x.09) dans le cas d'un entraînement FSP: L'attribution de connexion est définie comme suit: (C-CON - Commande d'entraînement - S-0-1050.x.06) (C-CON - Etat d'entraînement - S-0-1050.x.06)
	10	télégramme standard (voir S-0-0015 Entraînement FSP)
	11	(réservé)

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Numéro de bit	Valeur	Description
3	—	mécanisme de production (pour les producteurs uniquement, pour les consommateurs, "sans importance" (don't care')
	0	cycle du producteur synchrone
	1	asynchrone
2	—	(réservé)
1-0	—	mécanisme de surveillance (pour les consommateurs uniquement, pour les producteurs, "sans importance" (don't care')
	00	fonctionnement synchrone du cycle du producteur (durée définie par S-0-1050.x.10)
	01	fonctionnement asynchrone avec chien de garde (temporisation pour le chien de garde définie par le produit de S-0-1050.x.10 et S-0-1050.x.11)
	10	fonctionnement asynchrone sans chien de garde
	11	(réservé)

NOTE Ce bit est protégé en écriture si l'esclave prend en charge uniquement SCP_FixCFG et également les classes SCP contenant S-0-1050.x.01.

A.3.116 IDN S-0-1050.x.2 Numéro de connexion

A.3.116.1 Attributs

Le Tableau A.144 présente les attributs potentiels pour cet IDN.

Tableau A.144 – Attributs de l'IDN S-0-1050.x.2

Attribut	Valeur
Nom	Numéro de connexion
Version	—
Longueur	2
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	0
Valeur d'entrée maximale	65 535
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.116.2 Description

Le numéro de connexion permet d'identifier une connexion. Le producteur et tous les consommateurs de la même connexion doivent avoir le même numéro de connexion.

A.3.117 IDN S-0-1050.x.3 Attribution de télégrammes

A.3.117.1 Attributs

Le Tableau A.145 présente les attributs potentiels pour cet IDN.

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Tableau A.145 – Attributs de l'IDN S-0-1050.x.3

Attribut	Valeur
Nom	Attribution de télégrammes
Version	—
Longueur	2
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.117.2 Description

L'attribution de télégrammes contient

- le type de message (MDT ou AT),
- le numéro de télégrammes, et
- le décalage de télégramme de la commande de connexion

pour la connexion concernée. Le type et le numéro de télégrammes définissent le télégramme de Type 19 de la connexion. Le décalage de télégramme doit débuter à la fin de l'en-tête de Type 19 (S3H) et définit la position de la commande de connexion (C-CON) de cette connexion. Le maître détermine l'attribution de télégrammes pour chaque connexion et doit la transmettre aux esclaves associés en phase CP2 (voir Tableau A.146). L'attribution de télégrammes doit correspondre à un nombre pair.

Tableau A.146 – Structure d'attribution de télégrammes

Numéro de bit	Valeur	Description
15-14	—	(réservé)
13-12	—	Numéro de télégramme
	00	MDT0 ou AT0
	01	MDT1 ou AT1
	10	MDT2 ou AT2
	11	MDT3 ou AT3
11	—	Type de message
	0	AT
	1	MDT
10-0	—	Décalage de télégramme de la commande de connexion (en octets)
	0 … 1492	Décalage de télégramme dans le MDT ou l'AT (doit être un nombre pair)

A.3.118 IDN S-0-1050.x.4 Longueur maximale de connexion

A.3.118.1 Attributs

Le Tableau A.147 présente les attributs potentiels pour cet IDN.

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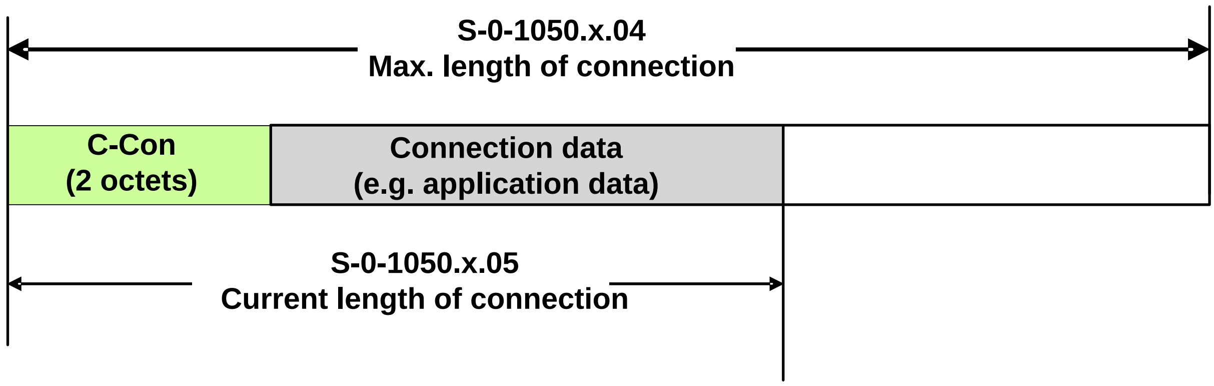
Tableau A.147 – Attributs de l'IDN S-0-1050.x.4

Attribut	Valeur
Nom	Longueur maximale de connexion
Version	—
Longueur	2
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	2
Valeur d'entrée maximale	spécifique au produit ou S-0-1060.x.04
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.118.2 Description

Ce paramètre définit la longueur maximale de cette connexion. Les 2 octets pour la commande de connexion (C-CON) font partie intégrante de cette longueur. Lorsque l'esclave présente une longueur de n octets, cette longueur contient 2 octets C-CON et n-2 données d'octets (voir Figure A.14).



Légende

Anglais	Français
Max. length of connection	Longueur maximale de connexion
C-Con	Commande de connexion
Connection data (e.g. application data)	Données de connexion (par exemple, données d'application)
Current length of connection	Longueur actuelle de connexion

Figure A.14 – Définition de la longueur de connexion

A.3.119 IDN S-0-1050.x.5 Longueur actuelle de connexion

A.3.119.1 Attributs

Le Tableau A.148 présente les attributs potentiels pour cet IDN.

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Tableau A.148 – Attributs de l'IDN S-0-1050.x.5

Attribut	Valeur
Nom	Longueur actuelle de connexion
Version	—
Longueur	2
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.119.2 Description

Ce paramètre définit la longueur actuelle de cette connexion et doit être un nombre pair d'octets. Les 2 octets pour la commande de connexion (C-CON) font partie intégrante de cette longueur. Lorsque l'esclave présente une longueur de n octets, cette longueur contient 2 octets C-CON et n-2 données d'octets (voir Figure A.14). Ce paramètre doit être actualisé par l'esclave en cas de modification des paramètres de configuration.

A.3.120 IDN S-0-1050.x.6 Liste de configuration

A.3.120.1 Attributs

Le Tableau A.149 présente les attributs potentiels pour cet IDN.

Tableau A.149 – Attributs de l'IDN S-0-1050.x.6

Attribut	Valeur
Nom	Liste de configuration
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.120.2 Description

Lorsque les données de connexion sont configurées avec des IDN (type de connexion, bit 5-4 = 00, dans S-0-1050.x.1), ce paramètre contient la liste des numéros d'identification de cette connexion. La séquence des IDN dans ce paramètre et la séquence des données d’exploitation correspondantes dans la connexion sont identiques.

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A.3.121 IDN S-0-1050.x.7 Capacité de connexion attribuée

A.3.121.1 Attributs

Le Tableau A.150 présente les attributs potentiels pour cet IDN.

Tableau A.150 – Attributs de l'IDN S-0-1050.x.7

Attribut	Valeur
Nom	Capacité de connexion attribuée
Version	—
Longueur	2
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	0
Valeur d'entrée maximale	255 et 0xFFFF
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.121.2 Description

Ce paramètre présente la capacité de connexion configurée de cette connexion. Par conséquent, le paramètre contient l'instance de structure de la capacité de connexion souhaitée (S-0-1060). Si ce paramètre est en lecture seule, l'esclave a une structure de connexion fixe.

La valeur par défaut qui doit être 0xFFFF (capacités de connexion ou S-0-1060) n'est pas utilisée.

A.3.122 IDN S-0-1050.x.8 Commande de connexion

A.3.122.1 Attributs

Le Tableau A.151 présente les attributs potentiels pour cet IDN.

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Tableau A.151 – Attributs de l'IDN S-0-1050.x.8

Attribut	Valeur
Nom	Commande de connexion
Version	—
Longueur	2
Format d'affichage	Binaire
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.122.2 Description

Ce paramètre contient l'image du mot de commande C-CON de cette connexion (voir Tableau 44).

A.3.123 IDN S-0-1050.x.10 Durée du cycle du producteur

A.3.123.1 Attributs

Le Tableau A.152 présente les attributs potentiels pour cet IDN.

Tableau A.152 – Attributs de l'IDN S-0-1050.x.10

Attribut	Valeur
Nom	Durée du cycle du producteur
Version	—
Longueur	4
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	31 250 (31,250 μs)
Valeur d'entrée maximale	spécifique au produit
Positions après la décimale	3
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	0,001 μs
Unité	μs

A.3.123.2 Description

Il convient que la durée du cycle du producteur soit un multiple entier de la durée de cycle de communication.

$$tPcyc = tScyc \cdot n \quad \forall n \in N$$

Les valeurs d'entrée minimales et maximales sont obligatoires.

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A.3.124 IDN S-0-1050.x.11 Pertes de données admises

A.3.124.1 Attributs

Le Tableau A.153 présente les attributs potentiels pour cet IDN.

Tableau A.153 – Attributs de l'IDN S-0-1050.x.11

Attribut	Valeur
Nom	Pertes de données admises
Version	—
Longueur	2
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.124.2 Description

Ce paramètre indique le nombre maximal de pertes consécutives de données du producteur, avant l'interruption d'une connexion. Lorsque cette connexion est interrompue, le consommateur ne doit plus traiter de données et définit l'erreur de connexion à l'état d'appareil. La valeur par défaut est de 1.

A.3.125 IDN S-0-1050.x.12 Pertes de données des compteurs d'erreurs

A.3.125.1 Attributs

Le Tableau A.154 présente les attributs potentiels pour cet IDN.

Tableau A.154 – Attributs de l'IDN S-0-1050.x.12

Attribut	Valeur
Nom	Pertes de données des compteurs d'erreurs
Version	—
Longueur	2
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

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A.3.125.2 Description

Ce paramètre compte le nombre de données du producteur perdues. Par conséquent, le consommateur compare le C.CON.counter par rapport à ses attentes. En cas de différence erronée, ce compteur d'erreurs est incrémenté de 1. Ce compteur doit être réinitialisé avec l'extrémité positive du producteur en position "Prêt" dans la commande de connexion, ou également si le maître commute de CP2 à CP3. Ce compteur ne comporte aucun dépassement et 65 535 constitue sa valeur finale.

A.3.126 IDN S-0-1050.x.20 Affectation des IDN de bits en temps réel

A.3.126.1 Attributs

Le Tableau A.155 présente les attributs potentiels pour cet IDN.

Tableau A.155 – Attributs de l'IDN S-0-1050.x.20

Attribut	Valeur
Nom	Affectation des IDN de bits en temps réel
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.126.2 Description

Afin d'attribuer des signaux aux bits en temps réel (voir S-0-0398 Liste des IDN de bits en temps réel configurables en tant que producteur et S-0-0399 Liste des IDN de bits en temps réel configurables en tant que consommateur), l'IDN du signal est saisi dans ce paramètre. Après l'attribution de l'IDN et du numéro de bit (voir S-0-1050.x.21 Affectation de bits en temps réel), le signal attribué est reproduit dans le bit en temps réel correspondant. Ce paramètre contient 2 éléments de liste au maximum.

La commande de connexion (C-CON) ou S-0-1050.x.08 comporte les bits en temps réel 1 et 2.

- L'élément de liste 0 correspond au bit en temps réel 1: IDN du signal attribué
- L'élément de liste 1 correspond au bit en temps réel 2: IDN du signal attribué

voir également Affectation de bits en temps réel ou IDN S-0-1050.x.21.

A.3.127 IDN S-0-1050.x.21 Affectation des IDN de bits en temps réel

A.3.127.1 Attributs

Le Tableau A.156 présente les attributs potentiels pour cet IDN.

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Tableau A.156 – Attributs de l'IDN S-0-1050.x.21

Attribut	Valeur
Nom	Affectation de bits en temps réel
Version	—
Longueur	2, variable
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.127.2 Description

Ce paramètre contient le numéro de bit des données d'exploitation attribuées à S-0-1050.x.20. Le signal attribué par un IDN (S-0-1050.x.20) et un numéro de bit (S-0-1050.x.21) est reproduit dans le bit en temps réel correspondant. Cette liste contient 2 entrées au maximum.

- L'élément de liste 0 correspond au bit en temps réel 1
- L'élément de liste 1 correspond au bit en temps réel 2

A.3.128 IDN S-0-1051 Schéma illustratif des configurations de connexion

A.3.128.1 Attributs

Le Tableau A.157 présente les attributs potentiels pour cet IDN.

Tableau A.157 – Attributs de l'IDN S-0-1051

Attribut	Valeur
Nom	Schéma illustratif des configurations de connexion
Version	—
Longueur	2, variable
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.128.2 Description

Cet IDN présente l'état réel de toutes les connexions de l'esclave, correspondant à S-0-1050.x.1.

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Le nombre d'éléments de liste présente le nombre maximal de connexions de cet esclave.

A.3.129 IDN S-0-1060.x.1 Configuration par défaut

A.3.129.1 Attributs

Le Tableau A.158 présente les attributs potentiels pour cet IDN.

Tableau A.158 – Attributs de l'IDN S-0-1060.x.01

Attribut	Valeur
Nom	Configuration par défaut
Version	—
Longueur	2
Format d'affichage	Binaire
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.129.2 Description

La structure de ce paramètre est identique à S-0-1050.x.01 et contient les paramètres par défaut des capacités de connexion (par exemple, consommateur ou producteur).

A.3.130 IDN S-0-1060.x.2 Masque de configuration

A.3.130.1 Attributs

Le Tableau A.159 présente les attributs potentiels pour cet IDN.

Tableau A.159 – Attributs de l'IDN S-0-1060.x.02

Attribut	Valeur
Nom	Masque de configuration
Version	—
Longueur	2
Format d'affichage	Binaire
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

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A.3.130.2 Description

La structure de ce paramètre est identique à celle de S-0-1050.x.01. Les bits à configuration variable sont réglés sur 1. Les bits à configuration non variable sont réglés sur 0.

A.3.131 IDN S-0-1060.x.3 Grandeur maximale de cette capacité de connexion

A.3.131.1 Attributs

Le Tableau A.160 présente les attributs potentiels pour cet IDN.

Tableau A.160 – Attributs de l'IDN S-0-1060.x.03

Attribut	Valeur
Nom	Grandeur maximale de cette capacité de connexion
Version	—
Longueur	2
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	1
Valeur d'entrée maximale	255
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.131.2 Description

Ce paramètre limite le nombre de connexions (S-0-1050.x.07) dans cette capacité de connexion.

A.3.132 IDN S-0-1060.x.4 Longueur maximale de connexion de la capacité de connexion

A.3.132.1 Attributs

Le Tableau A.161 présente les attributs potentiels pour cet IDN.

Tableau A.161 – Attributs de l'IDN S-0-1060.x.04

Attribut	Valeur
Nom	Longueur maximale de connexion de la capacité de connexion
Version	—
Longueur	2
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	2
Valeur d'entrée maximale	Spécifique au produit
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

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A.3.132.2 Description

Ce paramètre définit la longueur maximale de connexion de cette capacité de connexion. Les 2 octets de la commande de connexion (C-CON) font partie intégrante de cette longueur. Lorsque l'esclave présente une longueur de n octets, cette longueur contient 2 octets C-CON et n-2 données d'octets.

A.3.133 IDN S-0-1060.x.6 IDN configurables de la capacité de connexion

A.3.133.1 Attributs

Le Tableau A.162 présente les attributs potentiels pour cet IDN.

Tableau A.162 – Attributs de l'IDN S-0-1060.x.06

Attribut	Valeur
Nom	IDN configurables de la capacité de connexion
Version	—
Longueur	4, variable (liste triée par IDN)
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.133.2 Description

Ce paramètre contient les IDN configurables de la capacité de connexion qui peut être configurée dans la liste de configuration de la connexion (S-0-1050.x.06).

A.3.134 IDN S-0-1060.x.7 Temps de traitement maximal

A.3.134.1 Attributs

Le Tableau A.163 présente les attributs potentiels pour cet IDN.

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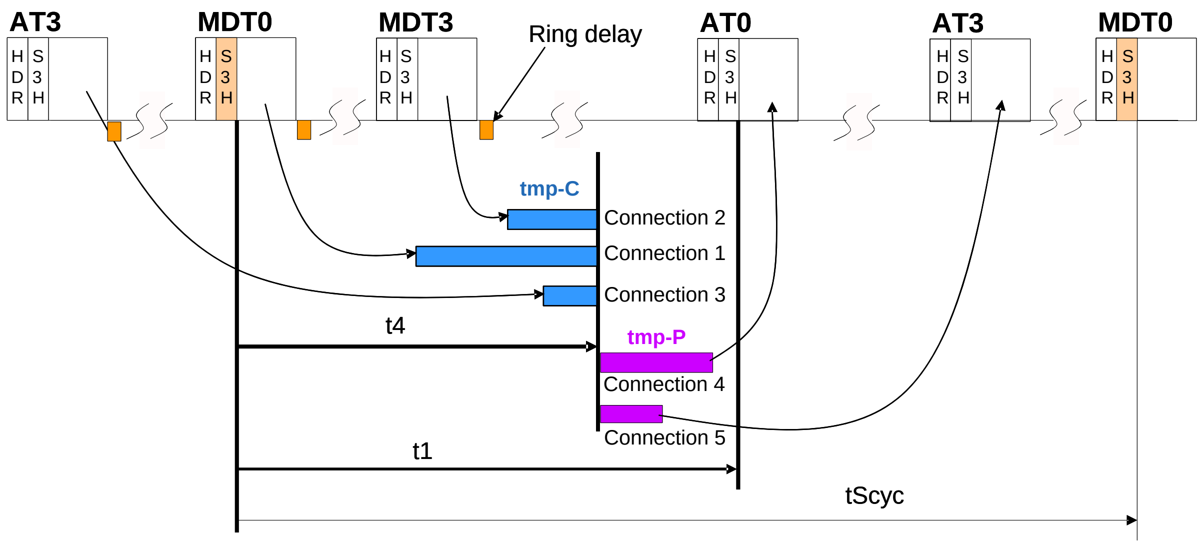
Tableau A.163 – Attributs de l'IDN S-0-1060.x.07

Attribut	Valeur
Nom	Temps de traitement maximal
Version	—
Longueur	4
Format d'affichage	Décimale
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	3
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	0,001 µs
Unité	—

A.3.134.2 Description

Le sous-appareil définit, dans le cadre de cette durée, le temps de traitement des données de la connexion en tant que producteur ou consommateur (voir Figure A.15).

- producteur: la génération des données du producteur nécessite le temps de traitement maximal (tmp-P) après le temps de synchronisation du cycle du producteur (T4pc).
- consommateur: le traitement des données du consommateur nécessite le temps de traitement maximal (tmp-C) après la fin du télégramme correspondant (MDT ou AT).



Légende

Anglais	Français
Ring delay	Retard de l'anneau
Connection	connexion

Figure A.15 – Synchronisation avec anneau

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A.3.135 IDN S-0-1060.x.10 Durée minimale du cycle du producteur

A.3.135.1 Attributs

Le Tableau A.164 présente les attributs potentiels pour cet IDN.

Tableau A.164 – Attributs de l'IDN S-0-1060.x.10

Attribut	Valeur
Nom	Durée minimale du cycle du producteur
Version	—
Longueur	4
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	31 250 (31,250 µs)
Valeur d'entrée maximale	—
Positions après la décimale	3
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	0,001 µs
Unité	—

A.3.135.2 Description

Ce paramètre contient la durée minimale du cycle du producteur prise en charge pour cette capacité de connexion.

A.3.136 IDN S-0-1061 Compteur TSref maximal

A.3.136.1 Attributs

Le Tableau A.165 présente les attributs potentiels pour cet IDN.

Tableau A.165 – Attributs de l'IDN S-0-1061

Attribut	Valeur
Nom	Compteur TSref maximal
Version	—
Longueur	2
Format d'affichage	Décimale
Valeur d'entrée minimale	0
Valeur d'entrée maximale	16 383
Positions après la décimale	0
Protection en écriture	CP3, CP4
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

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A.3.136.2 Description

Ce paramètre contient la valeur maximale du compteur Tsref dans le champ étendu de MDT0. Ce paramètre est nécessaire si l'application fonctionne avec différentes durées du cycle du producteur. Le maître doit prendre en charge la séquence suivante:

- détermination du plus petit commun multiple (PPCM) de toutes les durées du cycle du producteur (tPcyc) qui doivent être synchronisées pour l'application,
- le résultat est divisé par la durée de cycle de communication (tScyc) afin d'obtenir un nombre PPCM sur la base de tScyc,
- Le nombre PPCM doit être décrémenté de 1 et saisi dans ce paramètre.

Si ce paramètre est égal à 0, chacune des durées du cycle du producteur est alors égale à la durée de cycle de communication (chaque tPcyc = tScyc).

Le compteur TSref dans le champ étendu de MDT0 a une longueur de 14 bits, et la valeur maximale de ce paramètre est par conséquent limitée à la valeur de 16 383 (214 - 1). Ce paramètre est utilisé comme valeur de module pour le compteur TSref.

A.3.137 IDN S-0-1080.x.02 Conteneur de listes RTB du producteur

A.3.137.1 Attributs

Le Tableau A.166 présente les attributs potentiels pour cet IDN.

Tableau A.166 – Attributs de l'IDN S-0-1080.x.02

Attribut	Valeur
Nom	Conteneur de listes RTB du producteur
Version	—
Longueur	1, variable
Format d'affichage	Binaire
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.137.2 Description

Les signaux peuvent être transmis en temps réel du producteur au consommateur grâce au conteneur de listes RTB du producteur. A cette fin, le conteneur de listes RTB du producteur doit être intégré dans une connexion du producteur.

Les bits internes au conteneur de listes RTB du producteur peuvent être définis grâce aux listes de configuration du conteneur de listes RTB du consommateur (voir S-0-1080.x.03 et S-0-1080.x.04).

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A.3.138 IDN S-0-1080.x.03 Affectation des IDN de conteneur de listes RTB du producteur

A.3.138.1 Attributs

Le Tableau A.167 présente les attributs potentiels pour cet IDN.

Tableau A.167 – Attributs de l'IDN S-0-1080.x.03

Attribut	Valeur
Nom	Affectation des IDN de conteneur de listes RTB du producteur
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.138.2 Description

Les bits internes au conteneur de listes RTB du producteur (S-0-1080.x.02) peuvent être définis grâce à la liste de configuration du conteneur de listes RTB du producteur représentée dans cet IDN. La séquence des IDN dans la liste de configuration détermine le programme de numérotation des bits dans le conteneur de listes RTB du producteur. Le premier IDN de la liste de configuration avec le premier numéro de bit de S-0-1080.x.04 définit le bit 0 du conteneur de listes RTB du producteur.

A.3.139 IDN S-0-1080.x.04 Affectation de bits de conteneur de listes RTB du producteur

A.3.139.1 Attributs

Le Tableau A.168 présente les attributs potentiels pour cet IDN.

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Tableau A.168 – Attributs de l'IDN S-0-1080.x.04

Attribut	Valeur
Nom	Affectation de bits de conteneur de listes RTB du producteur
Version	—
Longueur	2, variable
Format d'affichage	Décimale non signée (numéro de bit)
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.139.2 Description

Les numéros de bit des données d'exploitation sont programmés dans cette liste de configuration et sont reproduits dans le conteneur de listes RTB du producteur (S-0-0180.x.02). La séquence des numéros de bit dans la liste de configuration détermine l'ordre numérique dans le conteneur de listes RTB du producteur. Le premier numéro de bit de la liste de configuration avec le premier IDN de S-0-1080.x.03 définit le bit 0 du conteneur de listes RTB du producteur.

A.3.140 IDN S-0-1081.x.02 Conteneur de listes RTB du consommateur

A.3.140.1 Attributs

Le Tableau A.169 présente les attributs potentiels pour cet IDN.

Tableau A.169 – Attributs de l'IDN S-0-1081.x.02

Attribut	Valeur
Nom	Conteneur de listes RTB du consommateur
Version	—
Longueur	1, variable
Format d'affichage	Binaire
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.140.2 Description

Les signaux peuvent être transmis en temps réel du producteur au consommateur grâce au conteneur de listes RTB du consommateur. A cette fin, le conteneur de listes RTB du consommateur doit être intégré dans une connexion du consommateur.

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Les bits internes au conteneur de listes RTB du consommateur peuvent être définis grâce aux listes de configuration du conteneur de listes RTB du consommateur (voir S-0-1081.x.03 et S-0-1081.x.04).

A.3.141 IDN S-0-1081.x.03 Affectation des IDN de conteneur de listes RTB du consommateur

A.3.141.1 Attributs

Le Tableau A.170 présente les attributs potentiels pour cet IDN.

Tableau A.170 – Attributs de l'IDN S-0-1081.x.03

Attribut	Valeur
Nom	Affectation des IDN de conteneur de listes RTB du consommateur
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.141.2 Description

Les bits internes au conteneur de listes RTB du consommateur (S-0-1081.x.02) peuvent être définis grâce à la liste de configuration du conteneur de listes RTB du consommateur représentée dans cet IDN. La séquence des IDN dans la liste de configuration détermine le programme de numérotation des bits dans le conteneur de listes RTB du consommateur. Le premier IDN de la liste de configuration avec le premier numéro de bit de S-0-1081.x.04 définit le bit 0 du conteneur de listes RTB du consommateur.

A.3.142 IDN S-0-1081.x.04 Affectation de bits de conteneur de listes RTB du consommateur

A.3.142.1 Attributs

Le Tableau A.171 présente les attributs potentiels pour cet IDN.

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Tableau A.171 – Attributs de l'IDN S-0-1081.x.04

Attribut	Valeur
Nom	Affectation de bits de conteneur de listes RTB du consommateur
Version	—
Longueur	2, variable
Format d'affichage	Décimale non signée (numéro de bit)
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.142.2 Description

Les numéros de bit des données d'exploitation sont programmés dans cette liste de configuration, et sont reproduits dans le conteneur de listes RTB du producteur (S-0-0180.x.02). La séquence des numéros de bit dans la liste de configuration détermine l'ordre numérique dans le conteneur de listes RTB du producteur. Le premier numéro de bit de la liste de configuration avec le premier IDN de S-0-1080.x.03 définit le bit 0 du conteneur de listes RTB du producteur.

A.3.143 IDN S-0-1099.0.1 Contrôle des IDN d'essai à des fins de conformité SCP

A.3.143.1 Attributs

Le Tableau A.172 présente les attributs potentiels pour cet IDN.

Tableau A.172 – Attributs de l'IDN S-0-1099.0.1

Attribut	Valeur
Nom	Contrôle des IDN d'essai à des fins de conformité SCP
Version	—
Longueur	2
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Jamais
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.143.2 Description

Cet IDN contrôle (voir Tableau A.173) le comportement du Conteneur des IDN d'essai à des fins de conformité SCP ou S-0-1099.0.2 et une autre fonctionnalité de Type 19. La certification de Type 19 l'utilise pour vérifier si l'esclave traite les données correctement. Les

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bits 14-8 définissent le groupe d'essai qui est effectivement activé. Les essais spécifiques au groupe d'essai peuvent être choisis parmi les bits 0-7.

Tableau A.173 – Structure de contrôle des IDN d'essai

Numéro de bit	Valeur	Description
15	—	Type de contrôle
	0	spécifique à l'application (les groupes d'essai et les cas d'essai respectent la spécification)
	1	spécifique au constructeur (les groupes d'essai et les cas d'essai sont définis par le constructeur)
14-8	—	Groupe d'essai - décrit le groupe d'essai (bit 7-0) effectivement utilisé
	0	sans importance (don't care') (IDN d'essai non actif)
	1	Données en temps réel
	2	SMP
7-4	—	Groupe d'essai - Données en temps réel
	0	sans importance (don't care') (IDN d'essai non actif)
	1	Incrémenter la valeur de S-0-1099.0.2 de 1
	2	Arrêt de commutation de Con-Counter de la connexion où S-0-1099.0.2 est défini de manière cyclique pour la valeur définie dans S-0-1099.0.2 cycles
3-0	—	Groupe d'essai - SMP
	0	Sans importance (don't care') (IDN d'essai non actif)
	1	Réception d'un message SMP et renvoi de ce télégramme par le conteneur de messages SMP configuré avec Session-ID+1 et priorité+1 dès la réception complète du message SMP.

A.3.144 IDN S-0-1099.0.2 Conteneur des IDN d'essai à des fins de conformité SCP

A.3.144.1 Attributs

Le Tableau A.174 présente les attributs potentiels pour cet IDN.

Tableau A.174 – Attributs de l'IDN S-0-1099.0.2

Attribut	Valeur
Nom	Conteneur des IDN d'essai à des fins de conformité SCP
Version	—
Longueur	2
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Jamais
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

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A.3.144.2 Description

La certification de Type 19 utilise cet IDN pour vérifier si l'esclave traite les données correctement. Pour ce faire, ce paramètre doit être traité comme tout autre paramètre, sauf qu'il peut être configuré dans une connexion produite et consommée pour un esclave simultanément. La lecture des données d'exploitation de cet IDN doit renvoyer la valeur configurée par le biais de S-0-1099.0.1 (Contrôle des IDN d'essai à des fins de conformité SCP).

A.3.145 IDN S-0-1100.0.1 Fragments SMP transmis par le compteur de diagnostic

A.3.145.1 Attributs

Le Tableau A.175 présente les attributs potentiels pour cet IDN.

Tableau A.175 – Attributs de l'IDN S-0-1100.0.1

Attribut	Valeur
Nom	Fragments SMP transmis par le compteur de diagnostic
Version	—
Longueur	4
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.145.2 Description

Ce paramètre affiche le nombre de fragments SMP transmis via la pile SMP depuis la commutation sur CP4. Le compteur est réglé sur 0 avant que la phase CP4 ne soit activée. Ce compteur s'arrête automatiquement aux valeurs comprises entre 2^{32}-1 et 0.

A.3.146 IDN S-0-1100.0.2 Fragments SMP reçus par le compteur de diagnostic

A.3.146.1 Attributs

Le Tableau A.176 présente les attributs potentiels pour cet IDN.

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Tableau A.176 – Attributs de l'IDN S-0-1100.0.2

Attribut	Valeur
Nom	Fragments SMP reçus par le compteur de diagnostic
Version	—
Longueur	4
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.146.2 Description

Ce paramètre affiche le nombre de fragments SMP reçus par la pile SMP depuis la commutation sur CP4. Ce compteur est réglé sur 0 avant que la phase CP4 ne soit activée. Ce compteur s'arrête automatiquement aux valeurs comprises entre 2^{32}-1 et 0.

A.3.147 IDN S-0-1100.0.3 Fragments SMP rejetés par le compteur de diagnostic

A.3.147.1 Attributs

Le Tableau A.177 présente les attributs potentiels pour cet IDN.

Tableau A.177 – Attributs de l'IDN S-0-1100.0.3

Attribut	Valeur
Nom	Fragments SMP rejetés par le compteur de diagnostic
Version	—
Longueur	4
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.147.2 Description

Ce paramètre affiche le nombre de fragments SMP reçus par la pile SMP et qui ont été supprimés du fait que son en-tête n'était pas adapté aux attentes du récepteur depuis la commutation sur CP4. Ce compteur est réglé sur 0 avant que la phase CP4 ne soit activée. Ce compteur s'arrête automatiquement aux valeurs comprises entre 2^{32}-1 et 0.

Les raisons à cela comprennent:

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- un ID de session non valide,
- un compteur de séquences erroné,
- une séquence incorrecte des bits FOS/LOS.

A.3.148 IDN S-0-1101.x.1 Données de conteneur SMP

A.3.148.1 Attributs

Le Tableau A.178 présente les attributs potentiels pour cet IDN.

Tableau A.178 – Attributs de l'IDN S-0-1101.x.1

Attribut	Valeur
Nom	Données de conteneur SMP
Version	—
Longueur	2, variable
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.148.2 Description

Ce paramètre contient les données réelles transmises via un conteneur SMP.

A.3.149 IDN S-0-1101.x.2 Liste des identifiants de session

A.3.149.1 Attributs

Le Tableau A.179 présente les attributs potentiels pour cet IDN.

Tableau A.179 – Attributs de l'IDN S-0-1101.x.2

Attribut	Valeur
Nom	Liste des identifiants de session
Version	—
Longueur	2, variable
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

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A.3.149.2 Description

Ce paramètre contient la liste de tous les identifiants de session établis actuellement pour un conteneur SMP. Chaque entrée de la liste correspond à l'entrée de liste avec le même index de S-0-1101.x.03 et définit l'identifiant pour cette session.

Les listes des éléments S-0-1101.x.02 et S-0-1101.x.03 doivent avoir la même longueur actuelle.

A.3.150 IDN S-0-1101.x.3 Liste des priorités de session

A.3.150.1 Attributs

Le Tableau A.180 présente les attributs potentiels pour cet IDN.

Tableau A.180 – Attributs de l'IDN S-0-1101.x.3

Attribut	Valeur
Nom	Liste des priorités de session
Version	—
Longueur	2, variable
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.150.2 Description

Ce paramètre contient une liste des valeurs de priorité pour les sessions de ce conteneur SMP. Chaque entrée de la liste correspond à l'entrée de liste avec le même index de S-0-1101.x.02 et définit la priorité pour cette session. La priorité la plus élevée est 0, et la priorité la moins élevée est 3.

Les listes des éléments S-0-1101.x.02 et S-0-1101.x.03 doivent avoir la même longueur actuelle.

A.3.151 IDN S-0-1150.x.01 Commande OVS (C-OVS)

A.3.151.1 Attributs

Le Tableau A.181 présente les attributs potentiels pour cet IDN.

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Tableau A.181 – Attributs de l'IDN S-0-1150.x.01

Attribut	Valeur
Nom	Commande OVS (C-OVS)
Version	—
Longueur	2
Format d'affichage	Binaire
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Jamais
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.151.2 Description

L'IDN contient un champ binaire grâce auquel l'utilisateur peut déclencher diverses actions du domaine de suréchantillonnage (voir Tableau A.182). La commande OVS (C-OVS) ne fait pas partie intégrante du conteneur. Elle peut être mappée avec la connexion sous son propre IDN.

Tableau A.182 – Structure de la commande OVS

Numéro de bit	Valeur	Description
15	—	Erreur de sortie
	0	aucune action
	1	erreur OVS de sortie
14-9	—	(réservé)
8	—	Contrôle de flux (active OVS)
	0	Exécution (OVS active)
	1	Arrêt (OVS passive)
7-0	—	(réservé)

A.3.152 IDN S-0-1150.x.02 Etat OVS (S-OVS)

A.3.152.1 Attributs

Le Tableau A.183 présente les attributs potentiels pour cet IDN.

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Tableau A.183 – Attributs de l'IDN S-0-1150.x.02

Attribut	Valeur
Nom	Etat OVS (S-OVS)
Version	—
Longueur	2
Format d'affichage	Binaire
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.152.2 Description

L'IDN contient un champ binaire grâce auquel l'utilisateur est informé de l'existence des divers états du domaine de suréchantillonnage (voir Tableau A.184). Le mot d'état OVS (S-OVS) ne fait pas partie intégrante du conteneur. Il peut être mappé avec la connexion sous son propre IDN.

Tableau A.184 – Structure de l'état OVS

Numéro de bit	Valeur	Description
15	—	Erreur
	0	le diagramme d'états OVS indique une erreur
	1	pas d’erreur
14-9	—	(réservé)
8	—	Arrêt OVS (indique l'état du diagramme d'états OVS)
	0	Exécution (OVS active)
	1	Arrêt (OVS passive)
7-0	—	(réservé)

A.3.153 IDN S-0-1150.x.03 Conteneur OVS

A.3.153.1 Attributs

Le Tableau A.185 présente les attributs potentiels pour cet IDN.

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Tableau A.185 – Attributs de l'IDN S-0-1150.x.03

Attribut	Valeur
Nom	Conteneur OVS
Version	—
Longueur	1, variable
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Conditionnel
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.153.2 Description

Les données d'exploitation de cet IDN contiennent les données OVS (voir Tableau A.186 et Figure A.16).

La taille du conteneur dépend du nombre d'échantillons (ou S-0-1150.x.10) et du nombre d'IDN, qui sont configurés dans la liste de configuration OVS - IDN (ou S-0-1150.x.06).

L'ordre des signaux dans ce conteneur suit l'ordre de la liste de configuration OVS - IDN (ou S-0-1150.x.06) et respectivement, de la liste de configuration OVS - Décalage (ou S-0-1150.x.07), ainsi que de la liste de configuration OVS - Longueur (ou S-0-1150.x.08).

Les données de chaque signal sont archivées sous forme de compression de bits. Les données des signaux suivants commencent à la limite d'octet suivante (alignée par octet).

Si l'esclave est le producteur des données du conteneur, ce dernier est toujours protégé en écriture.

Si l'esclave est le consommateur des données du conteneur, ce dernier est accessible en écriture.

Tableau A.186 – Exemple de configuration

S-0-1150.x.06 (IDN)	S-0-1150.x.07 (Décalage)	S-0-1150.x.08 (Longueur)	Explication
S-0-0135	0	0	16 bits, en commençant avec le bit 0 de l'IDN "S-0-0135" sont configurés.
S-0-1505.4.9	0	4	4 bits, en commençant avec le bit 0 de l'IDN "S-0-01505.4.9" sont configurés.
P-0-1213.7.5	2	3	3 bits, en commençant avec le bit 2 de l'IDN "P-0-1213.7.5" sont configurés.

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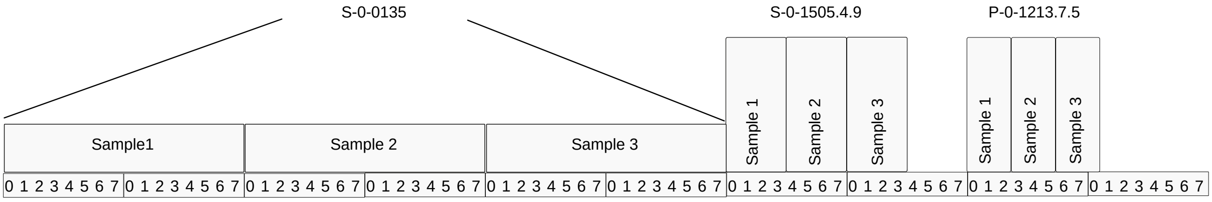

Légende

Anglais	Français
Sample	Echantillon

Figure A.16– Exemple de configuration

A.3.154 IDN S-0-1150.x.04 Durée d'échantillonnage

A.3.154.1 Attributs

Le Tableau A.187 présente les attributs potentiels pour cet IDN.

Tableau A.187 – Attributs de l'IDN S-0-1150.x.04

Attribut	Valeur
Nom	Durée d'échantillonnage
Version	—
Longueur	4
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	OL
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.154.2 Description

Cet IDN contient la durée d'échantillonnage; il s'agit du facteur spatio-temporel entre deux signaux. La sélection s'effectue selon la durée d'échantillonnage minimale ou S-0-1151.x.04.

La relation entre S-0-1150.x.04 Durée d'échantillonnage et S-0-1150.x.10 Nombre d'échantillons est la suivante:

- Si S-0-1150.x.10 Nombre d'échantillons, est saisi, les données d'exploitation de S-0-1150.x.04 Durée d'échantillonnage, sont calculées par l'esclave selon: S-0-1150.x.04 Durée d'échantillonnage = S-0-1050.x.10 Durée de cycle de production / S-0-1150.x.10 Nombre d'échantillons
- Si S-0-1150.x.04 Durée d'échantillonnage, est saisi, les données d'exploitation de S-0-1150.x.10 Nombre d'échantillons, sont calculées par l'esclave selon: S-0-1150.x.10 Nombre d'échantillons = S-0-1050.x.10 Durée de cycle de production / S-0-1150.x.10 Durée d'échantillonnage. Le résultat est arrondi s'il n'est pas un entier donné en nanosecondes.

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- Si le conteneur OVS correspondant n'a pas été configuré dans une connexion (par exemple pour OVS via SVC), aucun IDN S-0-1050.x.10, pouvant être utilisé pour le calcul de S-0-1150.x.04 n'est disponible. Dans ce cas, il faut que la configuration de l'automate de suréchantillonnage soit effectuée via S-0-1150.x.04 Durée d'échantillonnage.

A.3.155 IDN S-0-1150.x.05 Déphasage

A.3.155.1 Attributs

Le Tableau A.188 présente les attributs potentiels pour cet IDN.

Tableau A.188 – Attributs de l'IDN S-0-1150.x.05

Attribut	Valeur
Nom	Déphasage
Version	—
Longueur	4
Format d'affichage	Décimale signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	OL
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.155.2 Description

L'IDN contient la valeur du déphasage pour l'enregistrement/production.

Seuls les multiples relatifs de la durée d'échantillonnage minimale sont admis comme entrée.

Cette entrée permet le déphasage aval et amont de l'enregistrement. La durée de cycle du producteur détermine le déphasage maximal.

A.3.156 IDN S-0-1150.x.06 Liste de configuration OVS - IDN

A.3.156.1 Attributs

Le Tableau A.189 présente les attributs potentiels pour cet IDN.

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Tableau A.189 – Attributs de l'IDN S-0-1150.x.06

Attribut	Valeur
Nom	Liste de configuration OVS - IDN
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	OL
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.156.2 Description

La liste contient les entrées de l'IDN type.

Chaque entrée identifie un signal à échantillonner ou à produire par cet automate de suréchantillonnage.

L'utilisateur doit créer la liste à partir des données des IDN configurables de la liste de capacité OVS (ou S-0-1151.x.06)

A.3.157 IDN S-0-1150.x.07 Liste de configuration OVS - Décalage

A.3.157.1 Attributs

Le Tableau A.190 présente les attributs potentiels pour cet IDN.

Tableau A.190 – Attributs de l'IDN S-0-1150.x.07

Attribut	Valeur
Nom	Liste de configuration OVS - Décalage
Version	—
Longueur	2, variable
Format d'affichage	Entier non signé
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	OL
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.157.2 Description

Cet IDN contient une liste des décalages de bits, pouvant être utilisée conjointement à la liste de configuration OVS - Longueur (ou S-0-1150.x.08) pour traiter les signaux de bits

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particuliers des données d'exploitation de l'IDN correspondant dans la liste de configuration OVS (ou S-0-1150.x.06).

A.3.158 IDN S-0-1150.x.08 Liste de configuration OVS - Longueur

A.3.158.1 Attributs

Le Tableau A.191 présente les attributs potentiels pour cet IDN.

Tableau A.191 – Attributs de l'IDN S-0-1150.x.08

Attribut	Valeur
Nom	Liste de configuration OVS - Longueur
Version	—
Longueur	2, variable
Format d'affichage	Entier non signé
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	OL
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.158.2 Description

Cet IDN contient une liste des longueurs en bits, pouvant être utilisée conjointement à la liste de configuration OVS - Décalage (ou S-0-1150.x.07) pour traiter les signaux de bits particuliers des données d'exploitation de l'IDN correspondant dans la liste de configuration OVS (ou S-0-1150.x.06).

A.3.159 IDN S-0-1150.x.09 Capacité de suréchantillonnage attribuée

A.3.159.1 Attributs

Le Tableau A.192 présente les attributs potentiels pour cet IDN.

Tableau A.192 – Attributs de l'IDN S-0-1150.x.09

Attribut	Valeur
Nom	Capacité de suréchantillonnage attribuée
Version	—
Longueur	2
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	0
Valeur d'entrée maximale	255
Positions après la décimale	0
Protection en écriture	OL
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

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A.3.159.2 Description

Ce paramètre présente la capacité OVS configurée. Par conséquent, le paramètre contient l'instance de structure des capacités OVS souhaitées (S-0-1151).

Si l'esclave a une capacité de suréchantillonnage statique, ce paramètre doit être en lecture seule.

A.3.160 IDN S-0-1150.x.10 Nombre d'échantillons

A.3.160.1 Attributs

Le Tableau A.193 présente les attributs potentiels pour cet IDN.

Tableau A.193 – Attributs de l'IDN S-0-1150.x.10

Attribut	Valeur
Nom	Nombre d'échantillons
Version	—
Longueur	2
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	1
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	OL
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.160.2 Description

Cet IDN contient le nombre de valeurs à échantillonner.

Il faut que la valeur des données d'exploitation soit inférieure ou égale au nombre maximal d'échantillons (ou S-0-1151.x.01).

NOTE La relation entre S-0-1150.x.04 Durée d'échantillonnage et S-0-1150.x.10 Nombre d'échantillons est décrite dans Suréchantillonnage FG.

A.3.161 IDN S-0-1151.x.01 Nombre maximal d'échantillons

A.3.161.1 Attributs

Le Tableau A.194 présente les attributs potentiels pour cet IDN.

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Tableau A.194 – Attributs de l'IDN S-0-1151.x.01

Attribut	Valeur
Nom	Nombre maximal d'échantillons
Version	—
Longueur	2
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.161.2 Description

L'IDN contient le nombre maximal de valeurs échantillonnées/produites.

Les données d’exploitation de cet IDN sont synonymes de la capacité de mémoire disponible, et il convient de les considérer comme la valeur la plus défavorable. Cela signifie qu'il peut exister des configurations de la liste de configuration OVS - IDN (ou S-0-1150.x.06) qui n'autorisent pas le nombre maximal d'échantillons, comme cela est spécifié dans cet IDN.

A.3.162 IDN S-0-1151.x.02 Résolution interne

A.3.162.1 Attributs

Le Tableau A.195 présente les attributs potentiels pour cet IDN.

Tableau A.195 – Attributs de l'IDN S-0-1151.x.02

Attribut	Valeur
Nom	Résolution interne
Version	—
Longueur	2
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	ns

A.3.162.2 Description

L'IDN contient la résolution interne des signaux à échantillonner/produire. Cette valeur s'écarte généralement de la durée d'échantillonnage minimale (ou S-0-1151.x.04), dans la

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mesure où l'acceptation/transfert, l'archivage et la gestion durent plus longtemps que ce qu'autorise la référence temporelle générée dans le matériel.

A.3.163 IDN S-0-1151.x.03 Grandeur maximale de cette capacité de suréchantillonnage

A.3.163.1 Attributs

Le Tableau A.196 présente les attributs potentiels pour cet IDN.

Tableau A.196 – Attributs de l'IDN S-0-1151.x.03

Attribut	Valeur
Nom	Grandeur maximale de cette capacité de suréchantillonnage
Version	—
Longueur	2
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	1
Valeur d'entrée maximale	255
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.163.2 Description

L'IDN contient le nombre maximal de signaux qui peuvent être échantillonnés/produits simultanément dans un domaine. Cet élément de donnée est synonyme des ressources disponibles du matériel de suréchantillonnage. Cela signifie que plusieurs signaux peuvent être archivés lorsque les signaux du domaine à échantillonner/produire (S-0-1151.x.06 IDN configurables de la capacité OVS) sont choisis correctement et la mémoire est gérée de manière efficace.

A.3.164 IDN S-0-1151.x.04 Durée d'échantillonnage minimale

A.3.164.1 Attributs

Le Tableau A.197 présente les attributs potentiels pour cet IDN.

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Tableau A.197 – Attributs de l'IDN S-0-1151.x.04

Attribut	Valeur
Nom	Durée d'échantillonnage minimale
Version	—
Longueur	4
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	ns

A.3.164.2 Description

Cet IDN contient la durée d'échantillonnage minimale, qui constitue le facteur spatio-temporel le plus petit possible entre deux valeurs de signaux échantillonnés/produits.

La durée d'échantillonnage/production réelle est définie dans S-0-1150.x.04 Durée d'échantillonnage.

A.3.165 IDN S-0-1151.x.06 IDN configurables de capacité OVS

A.3.165.1 Attributs

Le Tableau A.198 présente les attributs potentiels pour cet IDN.

Tableau A.198 – Attributs de l'IDN S-0-1151.x.06

Attribut	Valeur
Nom	IDN configurables de capacité OVS
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.165.2 Description

La liste contient les entrées de l'IDN type. Chaque entrée identifie un signal qui peut être échantillonné ou produit avec cet automate de suréchantillonnage.

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A.3.166 IDN S-0-1151.x.07 IDN configurables de capacité OVS - Décalage

A.3.166.1 Attributs

Le Tableau A.199 présente les attributs potentiels pour cet IDN.

Tableau A.199 – Attributs de l'IDN S-0-1151.x.07

Attribut	Valeur
Nom	IDN configurables de capacité OVS - Décalage
Version	—
Longueur	2, variable
Format d'affichage	Entier non signé
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.166.2 Description

La liste contient les décalages de bits des IDN correspondants énumérés dans les IDN configurables de la capacité OVS (ou S-0-1151.x.06). Chaque entrée identifie un signal qui peut être échantillonné ou produit avec cet automate de suréchantillonnage.

A.3.167 IDN S-0-1151.x.08 IDN configurables de capacité OVS - Longueur

A.3.167.1 Attributs

Le Tableau A.200 présente les attributs potentiels pour cet IDN.

Tableau A.200 – Attributs de l'IDN S-0-1151.x.08

Attribut	Valeur
Nom	IDN configurables de capacité OVS - Longueur
Version	—
Longueur	2, variable
Format d'affichage	Entier non signé
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

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A.3.167.2 Description

La liste contient les longueurs en bits des IDN correspondants énumérés dans les IDN configurables de la capacité OVS (ou S-0-1151.x.06). Chaque entrée identifie un signal qui peut être échantillonné ou produit avec cet automate de suréchantillonnage.

Si la valeur "0" est saisie comme étant la longueur, l'entrée correspondante dans S-0-1151.x.07 IDN configurables de la capacité OVS - Décalage est ignorée et les données d'exploitation complètes de l'IDN défini dans S-0-1151.x.06 peuvent être choisies pour échantillonnage/production.

A.3.168 IDN S-0-1153 Nombre de domaines OVS

A.3.168.1 Attributs

Le Tableau A.201 présente les attributs potentiels pour cet IDN.

Tableau A.201 – Attributs de l'IDN S-0-1151.x.08

Attribut	Valeur
Nom	Nombre de domaines OVS
Version	—
Longueur	2
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

A.3.168.2 Description

Cet IDN contient le nombre de domaines de suréchantillonnage fournis par l'esclave.

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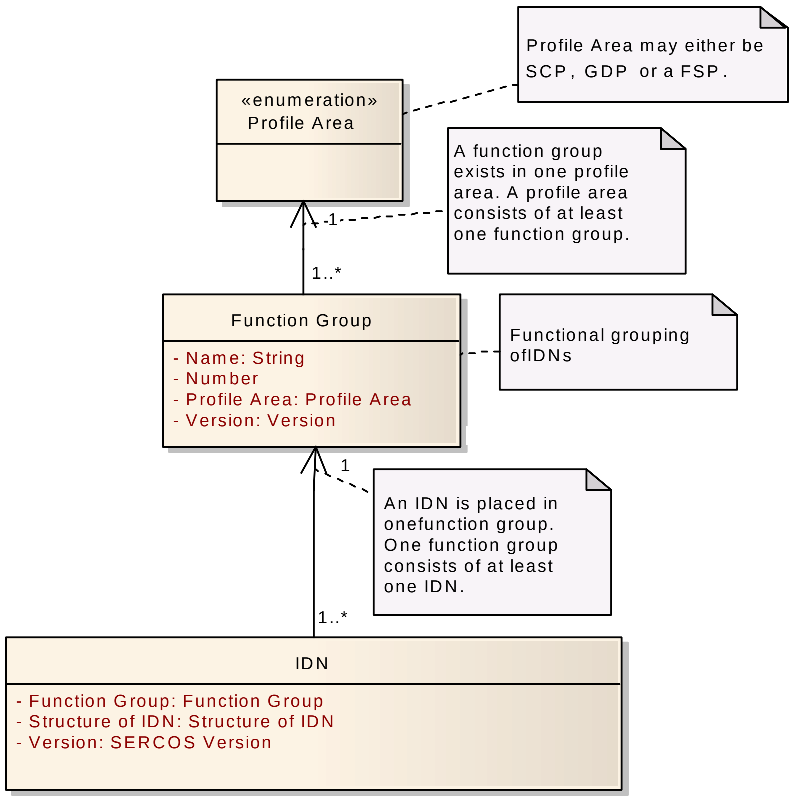
Annexe B
(normative)

Classification SCP

B.1 Concept général d'établissement de profils

Le Type 19 propose deux points de vue différents concernant le regroupement des IDN. L'aspect de la spécification constitue l'un de ces points de vue, un exemple concret d'application constituant l'autre point de vue.

La Figure B.1 illustre le point de vue technique. Chaque IDN existe dans un groupe de fonctions. Un groupe de fonctions constitue un regroupement fonctionnel des IDN. Chaque groupe de fonctions existe dans une zone appelée zone de profil. Cette zone peut être une SCP, GDP ou FSP (par exemple: FSP_Drive, FSP_IO).



Légende

Anglais	Français
Profile area may either be SCP, GDP or a FSP	La zone de profil peut être un SCP, un GDP ou un FSP
« enumeration » Profile area	Zone de profil « énumération »
A function group exists in one profile area. A profile area consists of at least one function group.	Un groupe de fonctions existe dans une zone de profil. Cette dernière consiste en un groupe de fonctions au moins.
Function Group	Groupe de fonctions
Name: String	Nom : Chaîne
Number	Nombre
Profile area	Zone de profil

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Anglais	Français
Functional grouping of IDNs	Regroupement fonctionnel des IDN
An IDN is placed in one function group. One function group consists of at least one IDN.	Un IDN est intégré à un groupe de fonctions. Ce dernier consiste en un IDN au moins
Structure of IDN	Structure de l'IDN
SERCOS version	Version SERCOS

Figure B.1 – Etablissement technique de profils du Type 19

Une application attend certaines fonctionnalités dans un appareil donné. Un autre point de vue concernant l'établissement de profils est ainsi présenté. On l'appelle établissement de profils d'application. Ce dernier utilise des classes permettant de regrouper les fonctionnalités décrites dans la spécification technique dans des groupes pouvant être mis en œuvre dans des appareils. Ceci permet aux constructeurs d'appareils esclaves de déterminer quelle fonctionnalité peut être classée dans un groupe de manière à avoir une certaine logique. Par ailleurs, ce point de vue facilite également la tâche des constructeurs d'appareils maîtres, dans la mesure où ce classement permet une bonne approche de l'appareil esclave.

Un IDN existe pour les zones de profils SCP et GDP, ledit IDN indiquant les classes mises en œuvre dans un appareil:

a) SCP: IDN S-0-1000 une fois par esclave
b) GDP: IDN S-0-1301 une fois par sous-appareil

Pour les appareils à structure modulaire, l'IDN suivant relatif à la zone de profil FSP existe:

a) FSP: IDN S-0-1302.x.2, un pour chaque ressource dans le sous-appareil

B.2 Groupes de fonctions associés au SCP

B.2.1 FG Identification SCP

Le groupe de fonctions FG Classification SCP regroupe tous les IDN associés à la classification d'un esclave au niveau SCP.

Ce groupe de fonctions inclut les IDN suivants:

- IDN S-0-1000.0.1 Classes SCP actives
- IDN S-0-1000 Type & Version SCP

B.2.2 FG Synchronisation

Le groupe de fonctions FG Synchronisation regroupe tous les IDN associés à la synchronisation. Ce groupe de fonctions inclut les IDN suivants:

- Durée de cycle de communication (tScyc) ou IDN S-0-1002
- Temps minimal de traitement de contrôle par retour (t5) ou IDN S-0-1005
- Temps de début de transmission de AT0 ou IDN S-0-1006 (t1)
- Période de validité de la valeur de commande ouIDN S-0-1008 (t3)
- Instabilité SYNC ou IDN S-0-1023
- Espace entre trames ou IDN S-0-1036
- Instabilité de l'esclave ou IDN S-0-1037
- Temps de validation de la valeur de commande AT (t9) ou IDN S-0-1041
- Temps d'activation maximal du consommateur (t11) ou IDN S-0-1047

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- Configuration par défaut ou IDN D-0-1060.x.01
- Masque de configuration ou IDN D-0-1060.x.02
- Grandeur maximale de la capacité de connexion ou IDN D-0-1060.x.03
- Longueur maximale de connexion de la capacité de connexion ou IDN D-0-1060.x.04
- IDN configurables de la capacité de connexion ou IDN D-0-1060.x.06
- Temps de traitement maximal ou IDN D-0-1060.x.07
- Durée minimale du cycle du producteur ou IDN D-0-1060.x.10

B.2.3 FG Configuration de télégrammes

Le groupe de fonctions FG Configuration de télégrammes regroupe tous les IDN associés à la configuration des télégrammes. Ce groupe de fonctions inclut les IDN suivants:

- Décalage de la commande d'appareil (C-DEV) dans le télégramme MDT ou IDN S-0-1009
- Longueurs des télégrammes MDT ou IDN S-0-1010
- Décalage de l'état d'appareil (S-DEV) dans le télégramme AT ou IDN S-0-1011
- Longueur de télégrammes AT ou IDN S-0-1012
- Décalage SVC dans le télégramme MDT ou IDN S-0-1013
- Décalage SVC dans le télégramme AT ou IDN S-0-1014

B.2.4 FG Commande

Le groupe de fonctions FG Commande regroupe tous les IDN, associés à la commande du diagramme d'états de communication de l'esclave. Ce groupe de fonctions inclut les IDN suivants:

- liste des IDN de données d'exploitation invalides pour CP2 ou IDN S-0-0021
- liste des IDN de données d'exploitation invalides pour CP3 ou IDN S-0-0022
- Contrôle de transition CP3 ou IDN S-0-0127
- Contrôle de transition CP4 ou IDN S-0-0128

B.2.5 FG Diagnostic de bus

Le groupe de fonctions FG Diagnostic de bus regroupe tous les IDN associés au diagnostic de bus. Ce groupe de fonctions inclut les IDN suivants:

- Etat d'interface ou IDN S-0-0014
- Pertes MST admises en CP3/CP4 ou IDN S-0-1003
- Version du matériel de communication ou IDN S-0-1026
- Compteur d'erreurs MST-P/S ou IDN S-0-1028
- Port 1 & Port 2 d'attribution de broches d'essai ou IDN S-0-1031
- Compteur d'erreurs PHY Port 1 & Port 2 ou IDN S-0-1034
- Port 1 & Port 2 du compteur d'erreurs ou IDN S-0-1035
- Adresse de sous-appareil ou IDN S-0-1040
- Commande d'appareil (C-DEV) ou IDN S-0-1044
- Etat d'appareil (S-DEV) ou IDN S-0-1045
- Liste d'adresses de sous-appareils dans l'appareil ou IDN S-0-1046

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B.2.6 FG Connexion

Le groupe de fonctions FG Connexion regroupe tous les IDN associés à la configuration des connexions. Ce groupe de fonctions inclut les IDN suivants:

- liste des IDN de données configurables en tant que producteur ou IDN S-0-0187
- liste des IDN de données configurables en tant que consommateur ou IDN S-0-0188
- Configuration de connexion ou IDN S-0-1050.x.01
- Numéro de connexion ou IDN S-0-1050.x02
- Attribution de télégrammes ou IDN S-0-1050.x.03
- Longueur maximale de connexion ou IDN S-0-1050.x.04
- Longueur actuelle de connexion ou IDN S-0-1050.x.05
- Liste de configuration ou IDN S-0-1050.x.06
- Capacité de connexion attribuée ou IDN S-0-1050.x.07
- Commande de connexion (C-CON) ou IDN S-0-1050.x.08
- Etat de connexion ou IDN S-0-1050.x.09
- Durée du cycle du producteur ou IDN S-0-1050.x.10
- Pertes de données admises ou IDN S-0-1050.x.11
- Pertes de données des compteurs d'erreurs ou IDN S-0-1050.x.12
- Connexions ou IDN S-0-1050
- Schéma illustratif des configurations de connexion ou IDN S-0-1051

B.2.7 FG NRT

Le groupe de fonctions FG Connexion regroupe tous les IDN associés à la communication dans le canal UC. Ce groupe de fonctions inclut les IDN suivants:

- Temps de transmission NRT ou IDN S-0-1017
- Adresse MAC ou IDN S-0-1019
- Adresse IP actuelle ou IDN S-0-1020.0.1
- Adresse IP ou IDN S-0-1020
- Masque de sous-réseau actuel ou IDN S-0-1021.0.1
- Masque de sous-réseau ou IDN S-0-1021
- Adresse de passerelle active actuelle ou IDN S-0-1022.0.1
- Adresse de passerelle ou IDN S-0-1022
- MTU demandée ou IDN S-0-1027.0.1
- MTU effective ou IDN S-0-1027.0.2
- Nom d'hôte actif actuel ou IDN S-0-1039.0.1
- Nom d'hôte ou IDN S-0-1039
- Activer les paramètres réseau ou IDN S-0-1048

et les bits de commande et d'état suivants

- C-DEV/Topologie physique de commande

B.2.8 FG MUX

Le groupe de fonctions FG MUX regroupe tous les IDN associés à l'utilisation du canal multiplex dans une connexion. Ce groupe de fonctions inclut les IDN suivants:

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- Conteneur A1 de données MDT ou IDN S-0-0360
- Conteneur B1 de données MDT ou IDN S-0-0361
- Index de liste de conteneurs A de données MDT ou IDN S-0-0362
- Index de liste de conteneurs B de données MDT ou IDN S-0-0363
- Conteneur A1 de données AT ou IDN S-0-0364
- Conteneur B1 de données AT ou IDN S-0-0365
- Index de liste de conteneurs A de données AT ou IDN S-0-0366
- index de liste de conteneurs B de données AT ou IDN S-0-0367
- Pointeur de conteneur A de données ou IDN S-0-0368
- Pointeur de conteneur B de données ou IDN S-0-0369
- Liste de configuration de conteneurs A/B de données MDT ou IDN S-0-0370
- Liste de configuration de conteneurs A/B de données AT ou IDN S-0-0371
- Liste des IDN de données configurables dans le conteneur de données AT ou IDN S-0-0444
- Liste des IDN de données configurables dans le conteneur de données MDT ou IDN S-0-0445
- Conteneur A2 de données MDT ou IDN S-0-0450
- Conteneur A3 de données MDT ou IDN S-0-0451
- Conteneur A4 de données MDT ou IDN S-0-0452
- Conteneur A5 de données MDT ou IDN S-0-0453
- Conteneur A6 de données MDT ou IDN S-0-0454
- Conteneur A7 de données MDT ou IDN S-0-0455
- Conteneur A8 de données MDT ou IDN S-0-0456
- Conteneur A9 de données MDT ou IDN S-0-0457
- Conteneur A10 de données MDT ou IDN S-0-0458
- Conteneur B2 de données MDT ou IDN S-0-0459
- Conteneur A2 de données AT ou IDN S-0-0480
- Conteneur A3 de données AT ou IDN S-0-0481
- Conteneur A4 de données AT ou IDN S-0-0482
- Conteneur A5 de données AT ou IDN S-0-0483
- Conteneur A6 de données AT ou IDN S-0-0484
- Conteneur A7 de données AT ou IDN S-0-0485
- Conteneur A8 de données AT ou IDN S-0-0486
- Conteneur A9 de données AT ou IDN S-0-0487
- Conteneur A10 de données AT ou IDN S-0-0488
- Conteneur B2 de données AT ou IDN S-0-0489
- Liste de configuration de conteneurs A2 de données MDT ou IDN S-0-0490
- Liste de configuration de conteneurs A3 de données MDT ou IDN S-0-0491
- Liste de configuration de conteneurs A4 de données MDT ou IDN S-0-0492
- Liste de configuration de conteneurs A5 de données MDT ou IDN S-0-0493
- Liste de configuration de conteneurs A6 de données MDT ou IDN S-0-0494
- Liste de configuration de conteneurs A7 de données MDT ou IDN S-0-0495

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- Liste de configuration de conteneurs A8 de données MDT ou IDN S-0-0496
- Liste de configuration de conteneurs A9 de données MDT ou IDN S-0-0497
- Liste de configuration de conteneurs A10 de données MDT0 ou IDN S-0-0498
- Liste de configuration de conteneurs A2 de données AT ou IDN S-0-0500
- Liste de configuration de conteneurs A3 de données AT ou IDN S-0-0501
- Liste de configuration de conteneurs A4 de données AT ou IDN S-0-0502
- Liste de configuration de conteneurs A5 de données AT ou IDN S-0-0503
- Liste de configuration de conteneurs A6 de données AT ou IDN S-0-0504
- Liste de configuration de conteneurs A7 de données AT ou IDN S-0-0505
- Liste de configuration de conteneurs A8 de données AT ou IDN S-0-0506
- Liste de configuration de conteneurs A9 de données AT ou IDN S-0-0507
- Liste de configuration de conteneurs A10 de données AT ou IDN S-0-0508

B.2.9 FG SMP

Le groupe de fonctions FG SMP regroupe tous les IDN, associés à l'utilisation du protocole de messagerie de Type 19 (SMP). Ce groupe de fonctions inclut les IDN suivants:

- Fragments SMP transmis par le compteur de diagnostic ou IDN S-0-1100.0.01
- Fragments SMP reçus par le compteur de diagnostic ou IDN S-0-1100.0.02
- Fragments SMP rejetés par le compteur de diagnostic ou IDN S-0-1100.0.03
- Données de conteneur SMP ou IDN S-0-1101.x.01
- Liste des identifiants de session ou IDN S-0-1101.x.02
- Liste des priorités de session ou IDN S-0-1101.x.03

B.2.10 FG RTB

Le groupe de fonctions FG RTB regroupe tous les IDN, associés à l'utilisation des bits en temps réel. Ce groupe de fonctions inclut les IDN suivants:

- Affectation des IDN de conteneur de mots RTB du producteur ou IDN S-0-0026
- Affectation des IDN de conteneur de mots RTB du consommateur ou IDN S-0-0027
- Conteneur de mots RTB du producteur ou IDN S-0-0144
- Conteneur de mots RTB du consommateur ou IDN S-0-0145
- Affectation de bits de conteneur de mots RTB du producteur ou IDN S-0-0328
- Affectation de bits de conteneur de mots RTB du consommateur ou IDN S-0-0329
- Liste des IDN de bits en temps réel configurables en tant que producteur ou IDN S-0-0398
- Liste des IDN de bits en temps réel configurables en tant que consommateur ou IDN S-0-0399
- Affectation des IDN de bits en temps réel ou IDN S-0-1050.x.20
- Affectation de bits en temps réel ou IDN S-0-1050.x.21
- Conteneur de listes RTB du producteur ou IDN S-0-1080.x.02
- Affectation des IDN de conteneur de listes RTB du producteur ou IDN S-0-1080.x.03
- Affectation de bits de conteneur de listes RTB du producteur ou IDN S-0-1080.x.04
- Conteneur de listes RTB du consommateur ou IDN S-0-1081.x.02
- Affectation des IDN de conteneur de listes RTB du consommateur ou IDN S-0-1081.x.03
- Affectation de bits de conteneur de listes RTB du consommateur ou IDN S-0-1081.x.04

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et les bits de commande et d'état suivants

- C-CON/Bit 1 en temps réel
- C-CON/Bit 1 en temps réel

B.3 Classes de communication de Type 19

B.3.1 Généralités

Le Type 19 définit plusieurs classes de communication qui peuvent être mises en œuvre par les esclaves. Deux de ces classes définissent la communication de base et sont mutuellement exclusives:

- SCP_FixCFG
- SCP_VarCFG

Les autres classes de communication peuvent être mises en œuvre au-dessus d'elles.

B.3.2 SCP_FixCFG

SCP_FixCfg est une classe de base de SCP. Un esclave, qui met en œuvre SCP_FixCfg fournit les caractéristiques suivantes au niveau de communication:

- Une voie de service complète (SVC).
- Une commande d'appareil cyclique et des mots d'état d'appareil.
- Deux connexions exactement sont prises en charge, une en tant que consommateur et l'autre en tant que producteur:
  - La connexion produite peut être intégrée à tout télégramme AT et utilise l'instance de structure 0 (IDN S-0-1050.0.y). La position de cette connexion ne dépend pas de l'emplacement d'intégration de l'état d'appareil.
  - La connexion consommée peut être intégrée à tout télégramme MDT ou AT et utilise l'instance de structure 1 (IDN S-0-1050.1.y). La position de cette connexion ne dépend pas de l'emplacement d'intégration de la commande d'appareil.
- Le contenu des connexions est défini par l'esclave et ne peut pas être modifié par le maître.
- Tous les IDN et bits énumérés sont obligatoires dans SCP_FixCFG.

Cette classe inclut les IDN suivants:

- liste des IDN de données d'exploitation invalides pour CP2 ou IDN S-0-0021
- liste des IDN de données d'exploitation invalides pour CP3 ou IDN S-0-0022
- Contrôle de transition CP3 ou IDN S-0-0127
- Contrôle de transition CP4 ou IDN S-0-0128
- Type & Version SCP ou IDN S-0-1000
- Durée de cycle de communication (tScyc) ou IDN S-0-1002
- Pertes MST admises en CP3/CP4 ou IDN S-0-1003
- Décalage de la commande d'appareil (C-DEV) dans le télégramme MDT ou IDN S-0-1009
- Longueurs des télégrammes MDT ou IDN S-0-1010
- Décalage de l'état d'appareil (S-DEV) dans le télégramme AT ou IDN S-0-1011
- Longueur de télégrammes AT ou IDN S-0-1012
- Décalage SVC dans le télégramme MDT ou IDN S-0-1013
- Décalage SVC dans le télégramme AT ou IDN S-0-1014

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- Temps de transmission NRT ou IDN S-0-1017
- Version du matériel de communication ou IDN S-0-1026
- Compteur d'erreurs Port 1 & Port 2 ou IDN S-0-1035
- Adresse de sous-appareil ou IDN S-0-1040
- Liste d'adresses de sous-appareils dans l'appareil ou IDN S-0-1046
- Attribution de télégrammes ou IDN S-0-1050.x.3
- Longueur actuelle de connexion ou IDN S-0-1050.x.5

Cette classe inclut les bits de commande et d'état suivants:

- C-CON/Nouvelles données (nouvelles données du producteur)
- C-CON/Producteur prêt
- C-DEV/Identification
- C-DEV/Topologie HS
- C-DEV/Contrôle de topologie
- S-DEV/Interface d'avertissement de communication
- S-DEV/Connexion d'erreur
- S-DEV/Etat de port
- S-DEV/Bit de changement de commande de procédure.
- S-DEV/Esclave valide
- S-DEV/niveau de sous-appareil
- S-DEV/Topologie HS
- S-DEV/Etat de topologie

B.3.3 SCP_FixCFG_0x02

La classe SCP_FixCFG_0x02 est la version 0x02 de la classe SCP_FixCFG. La prise en charge d'une toute dernière version de classe SCP implique également automatiquement la prise en charge de toutes les versions inférieures de cette classe. Cette version constitue une amélioration rétrocompatible de la classe SCP_FixCFG.

Cette classe inclut l'IDN suivant:

- Instabilité de l'esclave ou IDN S-0-1037

B.3.4 SCP_FixCFG_0x03

La classe SCP_FixCFG_0x03 est la version 0x03 de la classe SCP_FixCFG. La prise en charge d'une toute dernière version de classe SCP implique également automatiquement la prise en charge de toutes les versions inférieures de cette classe. Cette version constitue une amélioration rétrocompatible de la classe SCP_FixCFG.

Cette classe inclut l'IDN suivant:

- Etat de connexion ou IDN S-0-1050.x.09

Cette classe inclut les bits de commande et d'état suivants:

- C-CON/Compteur
- C-CON/Contrôle de flux

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B.3.5 SCP_VarCFG

SCP_VarCfg est une classe de base de SCP. Un esclave, qui met en œuvre SCP_VarCfg fournit les caractéristiques suivantes au niveau de communication:

- Une voie de service complète.
- Une commande d'appareil cyclique et des mots d'état cycliques.
- Un certain nombre de connexions sont prises en charge. L'esclave définit ce nombre et le fournit au maître.
  - Les connexions consommées peuvent être intégrées à tout télégramme MDT ou AT. La position de cette connexion ne dépend pas de l'emplacement d'intégration de la commande d'appareil.
  - Les connexions produites peuvent être intégrées à tout télégramme AT. La position de cette connexion ne dépend pas de l'emplacement d'intégration de l'état d'appareil.
- Il faut que le contenu de toutes les connexions soit configuré (par exemple, par le maître). L'esclave fournit des listes d'IDN, qui peuvent être produits et consommés de manière cyclique, de sorte que le maître puisse le déterminer.
- Tous les IDN et bits énumérés sont obligatoires dans SCP_VarCFG.

Cette classe inclut les IDN suivants:

- Etat d'interface ou IDN S-0-0014
- liste des IDN de données d'exploitation invalides pour CP2 ou IDN S-0-0021
- liste des IDN de données d'exploitation invalides pour CP3 ou IDN S-0-0022
- Contrôle de transition CP3 ou IDN S-0-0127
- Contrôle de transition CP4 ou IDN S-0-0128
- liste des IDN de données configurables en tant que producteur ou IDN S-0-0187
- liste des IDN de données configurables en tant que consommateur ou IDN S-0-0188
- Type & Version SCP ou IDN S-0-1000
- Durée de cycle de communication (tScyc) ou IDN S-0-1002
- Pertes MST admises en CP3/CP4 ou IDN S-0-1003
- Décalage de la commande d'appareil (C-DEV) dans le télégramme MDT ou IDN S-0-1009
- Longueurs des télégrammes MDT ou IDN S-0-1010
- Décalage de l'état d'appareil (S-DEV) dans le télégramme AT ou IDN S-0-1011
- Longueur des télégrammes AT ou IDN S-0-1012
- Décalage SVC dans le télégramme MDT ou IDN S-0-1013
- Décalage SVC dans le télégramme AT ou IDN S-0-1014
- Temps de transmission NRT ou IDN S-0-1017
- Version du matériel de communication ou IDN S-0-1026
- Compteur d'erreurs Port 1 & Port 2 ou IDN S-0-1035
- Adresse de sous-appareil ou IDN S-0-1040
- Liste d'adresses de sous-appareils dans l'appareil ou IDN S-0-1046
- Configuration de connexion ou IDN S-0-1050.x.01
- Numéro de connexion ou IDN S-0-1050.x02
- Attribution de télégrammes ou IDN S-0-1050.x.03
- Longueur maximale de connexion ou IDN S-0-1050.x.04
- Longueur actuelle de connexion ou IDN S-0-1050.x.05

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- Liste de configuration ou IDN S-0-1050.x.06
- Schéma illustratif des configurations de connexion ou IDN S-0-1051

Cette classe inclut les bits de commande et d'état suivants:

- C-CON/Nouvelles données (nouvelles données du producteur)
- C-CON/Producteur prêt
- C-DEV/Identification
- C-DEV/Topologie HS
- C-DEV/Contrôle de topologie
- S-DEV/Interface d'avertissement de communication
- S-DEV/Connexion d'erreur
- S-DEV/Etat de port
- S-DEV/Bit de changement de commande de procédure.
- S-DEV/Esclave valide
- S-DEV/Niveau de sous-appareil
- S-DEV/Topologie HS
- S-DEV/Etat de topologie

B.3.6 SCP_VarCFG_0x02

La classe SCP_VarCFG_0x02 constitue une extension de la classe SCP_VarCFG. Elle contient les informations concernant les connexions hétérogènes. La classe SCP_VarCFG_0x02 est la version 0x02 de la classe SCP_VarCFG. La prise en charge d'une toute dernière version de classe SCP implique également automatiquement la prise en charge de toutes les versions inférieures de cette classe. Cette version constitue une amélioration rétrocompatible de la classe SCP_VarCFG.

Cette classe inclut l'IDN suivant:

- Instabilité de l'esclave ou IDN S-0-1037

B.3.7 SCP_VarCFG_0x03

La classe SCP_VarCFG_0x03 est la version 0x03 de la classe SCP_VarCFG. La prise en charge d'une toute dernière version de classe SCP implique également automatiquement la prise en charge de toutes les versions inférieures de cette classe. Cette version constitue une amélioration rétrocompatible de la classe SCP_VarCFG.

Cette classe inclut l'IDN suivant:

- Etat de connexion ou IDN S-0-1050.x.09

Cette classe inclut les bits de commande et d'état suivants:

- C-CON/Compteur
- C-CON/Contrôle de flux

B.3.8 SCP_Sync

SCP_Sync est une classe de SCP. Un esclave, qui met en œuvre SCP_Sync, fournit une capacité de production et de consommation isochrone de données cycliques.

Cette classe inclut les IDN suivants:

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- Temps minimal de traitement de contrôle par retour (t5) ou IDN S-0-1005
- Temps de début de transmission de AT0 ou IDN S-0-1006 (t1)
- Temps de départ d'acquisition des données de contrôle par retour (t4) ou IDN S-0-1007
- Période de validité de la valeur de commande ou IDN S-0-1008 (t3)
- Retard de l'anneau ou IDN S-0-1015
- Retard de l'esclave (P/S) ou IDN S-0-1016
- Instabilité SYNC ou IDN S-0-1023
- Commande de procédure de mesure de retard SYNC ou IDN S-0-1024
- Temps de validation de la valeur de commande AT (t9) ou IDN S-0-1041
- Configuration de connexion ou IDN S-0-1050.x.01
- Durée du cycle du producteur ou IDN S-0-1050.x.10
- Pertes de données admises ou IDN S-0-1050.x.11
- Pertes de données des compteurs d'erreurs ou IDN S-0-1050.x.12

Cette classe inclut les bits de commande et d'état suivants:

- C-CON/Retard de champ de données
- C-CON/Synchronisation du producteur

B.3.9 SCP_Sync

SCP_Sync est une classe de SCP. Un esclave, qui met en œuvre SCP_Sync, fournit une capacité de production et de consommation isochrone de données cycliques.

Cette classe inclut les IDN suivants:

- Temps minimal de traitement de contrôle par retour (t5) ou S-0-1005
- Temps de début de transmission de AT0 ou S-0-1006 (t1)
- Temps de synchronisation (Tsync) ou S-0-1007
- Période de validité de la valeur de commande ou S-0-1008 (t3)
- Retard de l'anneau ou S-0-1015
- Retard de l'esclave (P&S) ou S-0-1016
- instabilité SYNC ou S-0-1023
- Commande de procédure de mesure de retard SYNC ou S-0-1024
- Temps de validation de la valeur de commande AT (t9) ou S-0-1041
- Configuration de connexion ou S-0-1050.x.01
- Durée du cycle du producteur ou S-0-1050.x.10
- Pertes de données admises ou S-0-1050.x.11
- Pertes de données des compteurs d'erreurs ou S-0-1050.x.12

et les bits de commande ou d'état suivants

- C-CON/Retard de champ de données
- C-CON/Synchronisation du producteur

B.3.10 SCP_Sync_0x02

SCP_Sync_0x02 est une classe du profil de communication de Type 19. Un esclave qui met en œuvre SCP_Sync_0x02, fournit la capacité de production et de consommation isochrones

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de données cycliques avec une durée de cycle de production (tPcyc) > durée de cycle de Type 19 (tScyc). La classe SCP_Sync_0x02 est la version 0x02 de la classe SCP_Sync. La prise en charge d'une toute dernière version de classe SCP implique également automatiquement la prise en charge de toutes les versions inférieures de cette classe. Cette version constitue une amélioration rétrocompatible de la classe SCP_Sync.

Cette classe inclut les IDN suivants:

- Compteur d'erreurs MST-P&S ou IDN S-0-1028
- Espace entre trames ou IDN S-0-1036
- Temps d'activation maximal du consommateur (t11) ou IDN S-0-1047

B.3.11 SCP_Sync_0x03

La classe SCP_Sync_0x03 est la version 0x03 de la classe SCP_Sync. La prise en charge d'une toute dernière version de classe SCP implique également automatiquement la prise en charge de toutes les versions inférieures de cette classe. Cette version constitue une amélioration rétrocompatible de la classe SCP_Sync.

Cette classe inclut l'IDN suivant:

- Compteur TSref maximal ou IDN S-0-1061

B.3.12 SCP_WD

SCP_WD est une classe de SCP. Un esclave, qui met en œuvre SCP_WD, fournit la capacité de contrôle des connexions consommées par l'esclave.

Cette classe inclut les IDN suivants:

- Configuration de connexion ou IDN S-0-1050.x.01
- Durée du cycle du producteur ou IDN S-0-1050.x.10

B.3.13 SCP_WD_0x02

SCP_WD_0x02 est une classe du profil de communication de Type 19. Un esclave, qui met en œuvre cette classe x02, fournit la capacité de surveiller le cycle de production de communication au moyen d'un chien de garde. La classe SCP_WD_0x02 est la version 0x02 de la classe SCP_WD. La prise en charge d'une toute dernière version de classe SCP implique également automatiquement la prise en charge de toutes les versions inférieures de cette classe. Cette version constitue une amélioration rétrocompatible de la classe SCP_WD.

Cette classe inclut l'IDN suivant:

- Pertes de données admises ou IDN S-0-1050.x.11

B.3.14 SCP_Diag

SCP_Diag est une classe de SCP. Un esclave, qui met en œuvre SCP_Diag, fournit des informations d'aide au diagnostic de bus.

Cette classe inclut les IDN suivants:

- liste des IDN de données d'exploitation invalides pour CP2 ou IDN S-0-0021
- liste des IDN de données d'exploitation invalides pour CP3 ou IDN S-0-0022
- Attribution de broches d'essai Port 1 & Port 2 ou IDN S-0-1031
- Commande d'appareil (C-DEV) ou IDN S-0-1044
- Etat d'appareil (S-DEV) ou IDN S-0-1045

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- Commande de connexion (C-CON) ou IDN S-0-1050.x.08
- Pertes de données des compteurs d'erreurs ou IDN S-0-1050.x.12

De plus, la DEL de Type 19 est prise en charge.

B.3.15 SCP_RTB

SCP_RTB est une classe de SCP. Un esclave, qui met en œuvre SCP_RTB, fournit la capacité de production et de consommation de bits en temps réel. Les bits en temps réel sont des signaux d'indication de certains états ou événements sélectionnés, qui sont par ailleurs représentés en temps réel.

Cette classe inclut les IDN suivants:

- Liste des IDN de bits en temps réel/d'état configurables ou IDN S-0-0398
- Liste des IDN de bits en temps réel/de commande configurables ou IDN/S-0-0399
- Affectation des IDN de bits en temps réel ou IDN S-0-1050.x.20
- Affectation de bits en temps réel ou IDN S-0-1050.x.21

Cette classe inclut les bits de commande ou d'état suivants:

- C-CON/Bit 1 en temps réel
- C-CON/Bit 2 en temps réel

B.3.16 SCP_HP

SCP_HP est une classe de SCP. Un esclave, qui met en œuvre SCP_HP fournit la capacité de connexion à chaud. Cela signifie qu'il est possible de l'intégrer à un réseau de Type 19 se trouvant déjà en phase de communication 4. Aucun IDN n'est associé à cette capacité, mais l'esclave doit mettre en œuvre l'utilisation des champs de connexion à chaud dans les télégrammes MDT et AT.

B.3.17 SCP_SMP

SCP_SMP est une classe de SCP. Un esclave, qui met en œuvre, SCP_SMP, fournit la capacité de participer à une connexion utilisant le protocole de messagerie de Type 19.

Cette classe inclut les IDN suivants:

- Fragments SMP transmis par le compteur de diagnostic ou IDN S-0-1100.0.01
- Fragments SMP reçus par le compteur de diagnostic ou IDN S-0-1100.0.02
- Fragments SMP rejetés par le compteur de diagnostic ou IDN S-0-1100.0.03
- Données de conteneur SMP ou IDN S-0-1101.x.01
- Liste des identifiants de session ou IDN S-0-1101.x.02
- Liste des priorités de session ou IDN S-0-1101.x.03

B.3.18 SCP_Mux

SCP_MuX est une classe de SCP. Un esclave, qui met en œuvre SCP_MuX fournit la capacité de production et de consommation de données cycliques multiplexées dans un conteneur de données standard dans une connexion unique.

Cette classe inclut les IDN suivants:

- Conteneur A1 de données MDT ou IDN S-0-0360
- Conteneur B1 de données MDT ou IDN S-0-0361

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- Conteneur A1 de données AT ou IDN S-0-0364
- Conteneur B1 de données AT ou IDN S-0-0365
- Pointeur de conteneur A de données ou IDN S-0-0368
- Pointeur de conteneur B de données ou IDN S-0-0369
- Liste de configuration de conteneurs A/B de données MDT ou IDN S-0-0370
- Liste de configuration de conteneurs A/B de données AT ou IDN S-0-0371

B.3.19 SCP_Ext_Mux

SCP_ExtMuX est une classe de SCP. Un esclave, qui met en œuvre SCP_ExtMuX fournit la capacité de production et de consommation de données cycliques multiplexées dans un conteneur de données étendu dans une connexion unique.

Cette classe inclut les IDN suivants:

- Conteneur A1 de données MDT ou IDN S-0-0360
- Conteneur A1 de données AT ou IDN S-0-0364
- Pointeur de conteneur A de données ou IDN S-0-0368
- Liste de configuration de conteneurs A/B de données MDT ou IDN S-0-0370
- Liste de configuration de conteneurs A/B de données AT ou IDN S-0-0371
- Conteneur A2 de données MDT ou IDN S-0-0450
- Conteneur A2 de données AT ou IDN S-0-0480
- Liste de configuration de conteneurs A2 de données MDT ou IDN S-0-0490
- Liste de configuration de conteneurs A2 de données AT ou IDN S-0-0500

B.3.20 SCP_NRT

SCP_NRT est une classe de SCP. Un esclave, qui met en œuvre SCP_NRT, fournit la capacité d'utiliser de manière active le canal UC aux fins de transmission et de réception de trames non SIII-Ethernet.

Cette classe ne doit pas être mise en œuvre dans les nouveaux appareils. Il faut en revanche mettre en œuvre SCP_NRTPC.

Cette classe inclut les IDN suivants:

- Adresse MAC ou IDN S-0-1019
- Adresse IP ou IDN S-0-1020
- Masque de sous-réseau ou IDN S-0-1021
- Adresse de passerelle ou IDN S-0-1022
- MTU demandée ou IDN S-0-1027.0.1
- MTU effective ou IDN S-0-1027.0.2

B.3.21 SCP_Sig

SCP_Sig est une classe de SCP. Un esclave, qui met en œuvre SCP-Sig, fournit la capacité de production d'un mot d'état de signal et de consommation d'un mot de commande de signal. Les signaux peuvent être transmis en temps réel du mot de commande et du mot d'état de signal. A cet effet, il est nécessaire que la commande de signal et le mot d'état de signal soient configurés dans une connexion.

Cette classe inclut les IDN suivants:

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- Liste de configuration pour le mot d'état de signal ou IDN S-0-0026
- Liste de configuration pour le mot de commande de signal ou IDN S-0-0027
- Mot d'état de signal ou IDN S-0-0144
- Mot de commande de signal ou IDN S-0-0144
- Liste d'attribution de numéro de bit pour le mot d'état de signal ou IDN S-0-0328
- Liste d'attribution de numéro de bit pour le mot de commande de signal ou IDN S-0-0329
- Liste des IDN de bits en temps réel/d'état configurables ou IDN S-0-0398
- Liste des IDN de bits en temps réel/de commande configurables ou IDN/S-0-0399

B.3.22 SCP_ListSeg

SCP_ListSeg est un sous-profil de SCP qui contient l'accès par segment des paramètres de longueur variable.

Cette classe inclut les IDN suivants:

- Liste des IDN ou IDN S-0-0394
- Index de liste ou IDN S-0-0395
- Nombre d'éléments de listes ou IDN S-0-0396
- Segment de liste ou IDN S-0-0397

B.3.23 SCP_IPS

SCP_IPS est une classe de SCP. Un esclave, qui met en œuvre SCP_IPS, fournit la capacité d'utiliser de manière active le canal UC aux fins de transmission et de réception, comme le définissent les réseaux de Type 19.

Les IPS regroupent les deux types de services suivants:

- Les services S/IP, qui sont des services spécifiques de Type 19 basés sur les protocoles UDP ou TCP
- D'autres services TFTP

B.3.24 SCP_Cap

SCP_Cap est une classe du profil de communication de Type 19. Un esclave, qui met en œuvre SCP_Cap fournit la capacité de présenter ses capacités de communication.

Cette classe inclut les IDN suivants:

- Capacité de connexion attribuée ou IDN S-0-1050.x.07
- Configuration par défaut ou IDN S-0-1060.x.01
- Masque de configuration ou IDN S-0-1060.x.02
- Grandeur maximale de cette capacité de connexion ou IDN S-0-1060.x.03
- Longueur maximale de connexion de la capacité de connexion ou IDN S-0-1060.x.04
- IDN configurables de la capacité de connexion ou IDN S-0-1060.x.06
- Temps de traitement maximal ou IDN S-0-1060.x.07
- Durée minimale du cycle du producteur ou IDN S-0-1060.x.10
- Capacités de connexion ou IDN S-0-1060

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B.3.25 SCP_RTBListProd

Si un esclave présente la classe SCP_RTBListProd, il prend alors en charge le conteneur de listes de bits en temps réel en tant que producteur.

Cette classe inclut les IDN suivants:

- Liste des IDN de bits en temps réel configurables en tant que producteur ou IDN S-0-0398
- Conteneur de listes RTB du producteur ou IDN S-0-1080.x.02
- Affectation des IDN de conteneur de listes RTB du producteur ou IDN S-0-1080.x.03
- Affectation de bits de conteneur de listes RTB du producteur ou IDN S-0-1080.x.04

B.3.26 SCP_RTBListCons

Si un esclave présente la classe SCP_RTBListCons, il prend alors en charge le conteneur de listes de bits en temps réel en tant que consommateur.

Cette classe inclut les IDN suivants:

- Liste des IDN de bits en temps réel configurables en tant que consommateur ou IDN S-0-0399
- Conteneur de listes RTB du consommateur ou IDN S-0-1081.x.02
- Affectation des IDN de conteneur de listes RTB du consommateur ou IDN S-0-1081.x.03
- Affectation de bits de conteneur de listes RTB du consommateur ou IDN S-0-1081.x.04

B.3.27 SCP_SysTime

Si un esclave présente la classe SCP_SysTime, il prend alors en charge le temps système transmis par le maître dans le champ étendu de MDT0.

B.3.28 SCP_RTBWordProd

Si un esclave présente la classe SCP_RTBWordProd, il prend alors en charge le mot en temps réel en tant que producteur.

Cette classe inclut les IDN suivants:

- IDN S-0-0026 Affectation des IDN de conteneur de mots RTB du producteur
- IDN S-0-0144 Conteneur de mots RTB du producteur
- IDN S-0-0328 Affectation de bits de conteneur de mots RTB du producteur
- IDN S-0-0398 Liste des IDN de bits en temps réel configurables en tant que producteur

B.3.29 SCP_RTBWordCons

Si un esclave présente la classe SCP_RTBWordCons, il prend alors en charge le mot en temps réel en tant que consommateur.

Cette classe inclut les IDN suivants:

- IDN S-0-0027 Affectation des IDN de conteneur de mots RTB du consommateur
- IDN S-0-0145 Conteneur de mots RTB du consommateur
- IDN S-0-0329 Affectation de bits de conteneur de mots RTB du consommateur
- IDN S-0-0399 Liste des IDN de bits en temps réel configurables en tant que consommateur

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B.3.30 SCP_SafetyCon

SCP_SafetyCon est une classe du profil de communication de Type 19. Un esclave, qui met en œuvre SCP_SafetyCon, fournit la fonctionnalité CSoS.

Cette classe inclut les IDN suivants:

- IDN S-0-1810.x.01 Durée de validité maximale des données SV
- IDN S-0-1810.x.02 Etat de programme de validation de sécurité
- IDN S-0-1810.x.03 Code d'erreur SV
- IDN S-0-1810.x.04 Type de programme de validation de sécurité
- IDN S-0-1810.x.05 Multiplicateur min de télégrammes de coordination temporelle SV
- IDN S-0-1810.x.06 Nombre maximal de consommateurs SV
- IDN S-0-1810.x.07 Multiplicateur de temporisation SV
- IDN S-0-1810.x.08 Multiplicateur EPI d'intervalles Ping SV
- IDN S-0-1810.x.09 Multiplicateur de délais prévus de réseau SV
- IDN S-0-1830.x.01 Conteneur SMP cyclique (externe)
- IDN S-0-1830.x.02 ID de session SMP cyclique (externe)
- IDN S-0-1830.x.03 Liste des conteneurs SMP cycliques (internes)
- IDN S-0-1830.x.04 Liste des ID de session SMP cycliques (internes)
- IDN S-0-1830.x.05 Liste des conteneurs SMP UCM (internes)
- IDN S-0-1830.x.07 Liste des conteneurs SMP UCM (externes)
- IDN S-0-1830.x.08 Liste des ID de session SMP UCM (externes)
- IDN S-0-1830.x.09 Liste des nombres de producteurs

B.3.31 SCP_OvS_Basic

SCP_ovSBasic est une classe du profil de communication de Type 19. Un esclave, qui met en œuvre SCP_OvSBasic fournit le mécanisme de base de la fonctionnalité de suréchantillonnage.

Cette classe inclut les IDN suivants:

- IDN S-0-1150.x.01 Commande OVS (C-OVS)
- IDN S-0-1150.x.02 Etat OVS (S-OVS)
- IDN S-0-1150.x.03 Conteneur OVS
- IDN S-0-1150.x.06 Liste de configuration OVS - IDN
- IDN S-0-1150.x.10 Nombre d'échantillons

et les bits de commande ou d'état suivants

- C-OVS Contrôle de flux
- C-OVS Erreur de sortie
- S-OVS erreur
- S-OVS arrêt

B.3.32 SCP_NRTPC

SCP_NRTPC est une classe de SCP. Un esclave, qui met en œuvre SCP_NRTPC, fournit la capacité d'utiliser de manière active le canal UC aux fins de transmission et de réception de trames Ethernet "autres que de Type 19".

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Cette classe inclut les IDN suivants:

- Adresse MAC ou IDN S-0-1019
- Adresse IP ou IDN S-0-1020
- Masque de sous-réseau ou IDN S-0-1021
- Adresse de passerelle ou IDN S-0-1022
- MTU demandée ou IDN S-0-1027.0.1
- MTU effective ou IDN S-0-1027.0.2
- Activer les paramètres réseau ou IDN S-0-1048

B.3.33 SCP_Cyc

SCP_Cyc est une classe du profil de communication de Type 19. Un esclave, qui met en œuvre SCP_Cyc, fournit une capacité de production et de consommation de données cycliques.

Cette classe inclut les IDN suivants:

- Temps minimal de traitement de contrôle par retour (t5) ou IDN S-0-1005
- Temps de début de transmission de AT0 ou IDN S-0-1006 (t1)
- Temps d'activation maximal du consommateur (t11) ou IDN S-0-1047

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Annexe C
(normative)

GDP (Profil d'appareil générique)

C.1 Généralités

L'objectif du profil d'appareil générique (GDP) est d'observer le sous-appareil qui ne dépend pas du profil spécifique à la fonction (FSP) mis en œuvre par le sous-appareil. Les parties suivantes sont indépendantes du FSP:

- Identification
- Administration
- Archivage
- Les diagrammes d'états GDP permettent le découplage du diagramme d'états de communication et d'application.

C.2 Groupes de fonctions

C.2.1 Groupe de fonctions Diagnostic

Le regroupement des IDN dans le groupe de fonctions Diagnostic a pour objectif de fournir au maître une interface définie dédiée aux tâches de diagnostic. Ceci inclut les tâches d'accès aux numéros et aux messages de diagnostic ainsi qu'aux datations correspondantes et à leur réinitialisation.

Ce groupe de fonctions inclut les IDN suivants:

- S-0-0095 Message de diagnostic
- S-0-0099 Diagnostic de classe 1 de réinitialisation
- S-0-0390 Numéro de diagnostic
- S-0-1303.0.01 Configuration de trace de diagnostic
- S-0-1303.0.02 Déclaration de trace de diagnostic
- S-0-1303.0.03 Etat de trace de diagnostic
- S-0-1303.0.10 Mémoire tampon de trace de diagnostic n°1
- S-0-1303.0.11 Mémoire tampon de trace de diagnostic n°2
- S-0-1303.0.12 Mémoire tampon de trace de diagnostic n°3
- S-0-1303 Trace de diagnostic

Outre ces IDN, une diode électroluminescente (DEL) de Type 19 fait partie intégrante de ce groupe de fonctions. Deux DEL sont définies:

- une DEL porte une étiquette S qui indique l'état de communication
- une DEL pour chaque sous-appareil portant une étiquette SDx qui indique l'état du sous-appareil x.

Si la DEL SDx est prise en charge, chaque sous-appareil de l'appareil doit comporter une DEL de ce type portant l'étiquette SD1, SD2, SD3, etc.

Lorsque l'appareil contient un seul sous-appareil, cette étiquette doit être marquée SD.

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DEL S

Un appareil de Type 19 doit obligatoirement présenter les états présentés dans le Tableau C.1 via une DEL portant une étiquette S ou comportant tout autre élément d'affichage.

L'appareil esclave indique le diagramme d'états de communication et trois états indépendants supplémentaires. Il s'agit du bouclage, de C1D et de l'identification. Les couleurs et la priorité sont présentés dans le Tableau C.1. L'identification des états est présentée avec la priorité la plus élevée.

Tableau C.1 – DEL de Type 19

Motif	Couleur	Description	Priorité	Commentaire
#1	Foncée	mode NRT	0	pas de communication de Type 19
#2	Orange	CP0	0	phase de communication 0 active
#3	Orange	CP1	0	phase de communication 1 active
#4		CP2	0	phase de communication 2 active
#5		CP3	0	phase de communication 3 active
#6	Vert	CP4	0	phase de communication 4 active
#7		HP0	1	Appareil en phase de connexion à chaud 0
#8		HP1	1	Appareil en phase de connexion à chaud 1
#9		HP2	1	Appareil en phase de connexion à chaud 2
#10		Acheminement rapide⇒ Bouclage	2	L'état RT est passé de l'état "acheminement rapide" à l'état "bouclage"
#11		erreur d'application	3	voir Erreur de classe de codes d'état GDP & FSP
#12		Pertes MST ≥ (S-0-1003/2)	4	tant que l'avertissement de communication (S-DEV.Bit15) dans l'état d'appareil est présent, au moins 2 sec.
#13	Rouge	erreur de communication	5	voir Erreur de classe de codes d'état SCP
#14		Identification	6	(C-DEV.Bit 15 dans la Commande d'appareil) utilisé pour l'attribution d'adresses, l'erreur de configuration ou autres fins d'identification
#15		Erreur de chien de garde	7	

La répartition du temps pour le clignotement des DEL doit être de 250 ms (4 Hz).

DEL SDx

Outre la DEL de Type 19, une autre DEL facultative est spécifiée (voir Tableau C.2). Cette DEL supplémentaire présente l'état du sous-appareil.

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Tableau C.2 – DEL SDx

Motif	Couleur	Description	Priorité	Commentaire
#1	foncée	sous-appareil non actif	0	
#2	orange	niveau de paramétrage (PL)	0	sous-appareil au niveau de paramétrage (PL)
#3	vert	niveau de fonctionnement (OL)	0	sous-appareil au niveau de fonctionnement
#4	rouge	erreur d'application (C1D)	1	voir Erreur de classe de codes d'état GDP & FSP

C.2.2 Groupe de fonctions Archivage

Le regroupement des IDN dans le groupe de fonctions Archivage a pour objectif de fournir au maître une interface définie dédiée aux tâches d'archivage. Ceci inclut les tâches d'accès aux listes de données qu'il est nécessaire d'archiver en vue d'une sauvegarde, les sommes de contrôle associées à ces données, ainsi que les commandes de procédure permettant d'effectuer cette sauvegarde, et de la rétablir.

Ce groupe de fonctions inclut les IDN suivants:

- S-0-0192 Liste des IDN de toutes les données d'exploitation de sauvegarde
- S-0-0262 Commande de procédure de défauts de charge
- S-0-0263 Commande de procédure de mémoire de travail de charge
- S-0-0264 Commande de procédure de mémoire de travail de sauvegarde
- S-0-0269 Mode d'archivage
- S-0-0270 Liste des IDN de données d'exploitation de sauvegarde sélectionnées
- S-0-0293 Commande de procédure de mémoire de travail de sauvegarde sélectionnée
- S-0-0326.x.0 Somme de contrôle des paramètres
- S-0-0327.x.0 Liste des IDN du paramètre de somme de contrôle
- S-0-0531 Somme de contrôle relative aux données d'exploitation de sauvegarde
- S-0-1310 Liste des IDN de données d'exploitation différentes des données par défaut

C.2.3 Groupe de fonctions Administration

Le regroupement des IDN dans le groupe de fonctions Administration a pour objectif de fournir au maître une interface définie dédiée aux tâches administratives. Ceci inclut les tâches de paramétrage de la langue du sous-appareil, ainsi que de définition d'un mot de passe utilisé pour modifier une liste de données.

Ce groupe de fonctions inclut les IDN suivants:

- S-0-0017 Liste des IDN de toutes les données d'exploitation
- S-0-0025 Liste des IDN de toutes les commandes de procédure
- S-0-0265 Choix de la langue
- S-0-0266 Liste des langues disponibles
- S-0-0267 Mot de passe
- S-0-0279 Liste des IDN de données protégées par mot de passe

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C.2.4 Groupe de fonctions Identification

Le regroupement des IDN dans le groupe de fonctions Identification a pour objectif de fournir au maître une interface définie dédiée aux tâches d'identification. Ceci inclut les tâches d'accès à toutes les étiquettes électroniques de tous les composants disponibles de l'appareil. Chacun de ces composants est par conséquent représenté par une instance de structure (SI) du paramètre d'étiquette électronique (S-0-1300). Une autre tâche couverte par ce groupe de fonctions GDP consiste à décrire le point de vue fonctionnel concernant le sous-appareil. Cela signifie la description de la couche application du sous-appareil (GDP + FSP).

Ce groupe de fonctions inclut les IDN suivants:

- S-0-1300.x.01 Nom de composant
- S-0-1300.x.02 Nom du fournisseur
- S-0-1300.x.03 Code fournisseur
- S-0-1300.x.04 Nom d'appareil
- S-0-1300.x.05 ID d'appareil du fournisseur
- S-0-1300.x.06 Connecté au sous-appareil
- S-0-1300.x.07 Révision des fonctions
- S-0-1300.x.08 Révision du matériel
- S-0-1300.x.09 Révision du logiciel
- S-0-1300.x.10 Révision du chargeur de micrologiciel
- S-0-1300.x.11 Numéro de commande
- S-0-1300.x.12 Numéro de série
- S-0-1300.x.13 Date de construction
- S-0-1300.x.14 Date AQ
- S-0-1300.x.20 Heures de fonctionnement
- S-0-1300.x.21 Date de service
- S-0-1300.x.22 Date d'étalonnage
- S-0-1300.x.23 Date limite d'étalonnage
- S-0-1300 Etiquette électronique
- S-0-1301 Liste des classes & Version GDP
- S-0-1302.x.01 Type & Version FSP
- S-0-1302.x.02 Groupes de fonctions
- S-0-1302.x.03 Type d'application
- S-0-1302 Structures de ressources de sous-appareil

C.2.5 Groupe de fonctions Diagramme d'états

C.2.5.1 Diagramme d'états de sous-appareil

Outre le diagramme d'états de communication, il faut que chaque sous-appareil mette en œuvre un diagramme d'états de sous-appareil qui représente l'état de fonctionnement de l'application (voir Figure C.1).

En général, le diagramme d'états de sous-appareil comporte deux états, à savoir le niveau de fonctionnement et le niveau de paramétrage.

- Niveau de paramétrage (PL)

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- Dans le niveau de paramétrage,
  - le sous-appareil désactive le contrôle des ressources associées (par exemple, codeur, moteur, ES). Les actions spécifiques aux ressources, nécessaires pour commuter sur le niveau de paramétrage, sont décrites dans les diagrammes d'états spécifiques aux ressources (par exemple, IO_state_machine ou digramme d'états d'entraînement). Avec l'activation du niveau de paramétrage, les bits de contrôle correspondants des mots d'état de ressources (par exemple, S-0-1500.x.02 Bit 15 d'état ES (données produites prêtes à l'emploi) ou S-0-0135 bits 15 et 14 de l'état d'entraînement) sont réglés sur 0.
  - les paramètres protégés en écriture au niveau de paramétrage (PL) ne peuvent pas être modifiés.
  - Dans la mesure où certaines fonctions de contrôle sont désactivées, il est possible d'échanger les ensembles d'un sous-appareil.
  - Le bit 4 (niveau de sous-appareil) du mot d'état d'appareil est réglé sur "1" (niveau de paramétrage (PL) actif).

- Niveau de fonctionnement (OL)
  - Dans le niveau de fonctionnement:
    - le sous-appareil est prêt à exécuter l'application. Tous les systèmes de surveillance sont mis sous tension;
    - Les paramètres protégés en écriture au niveau de fonctionnement (OL) ne peuvent pas être modifiés.
    - Le bit 4 (niveau de sous-appareil) du mot d'état d'appareil est réglé sur "0" (niveau de fonctionnement (OL) actif).
    - Tant que le sous-appareil ne prend pas en charge la classe "GDP_StM", le diagramme d'états de sous-appareil est couplé au diagramme d'états de communication. La Figure suivante présente la dépendance du diagramme d'états de sous-appareil vis-à-vis du diagramme d'états de communication.

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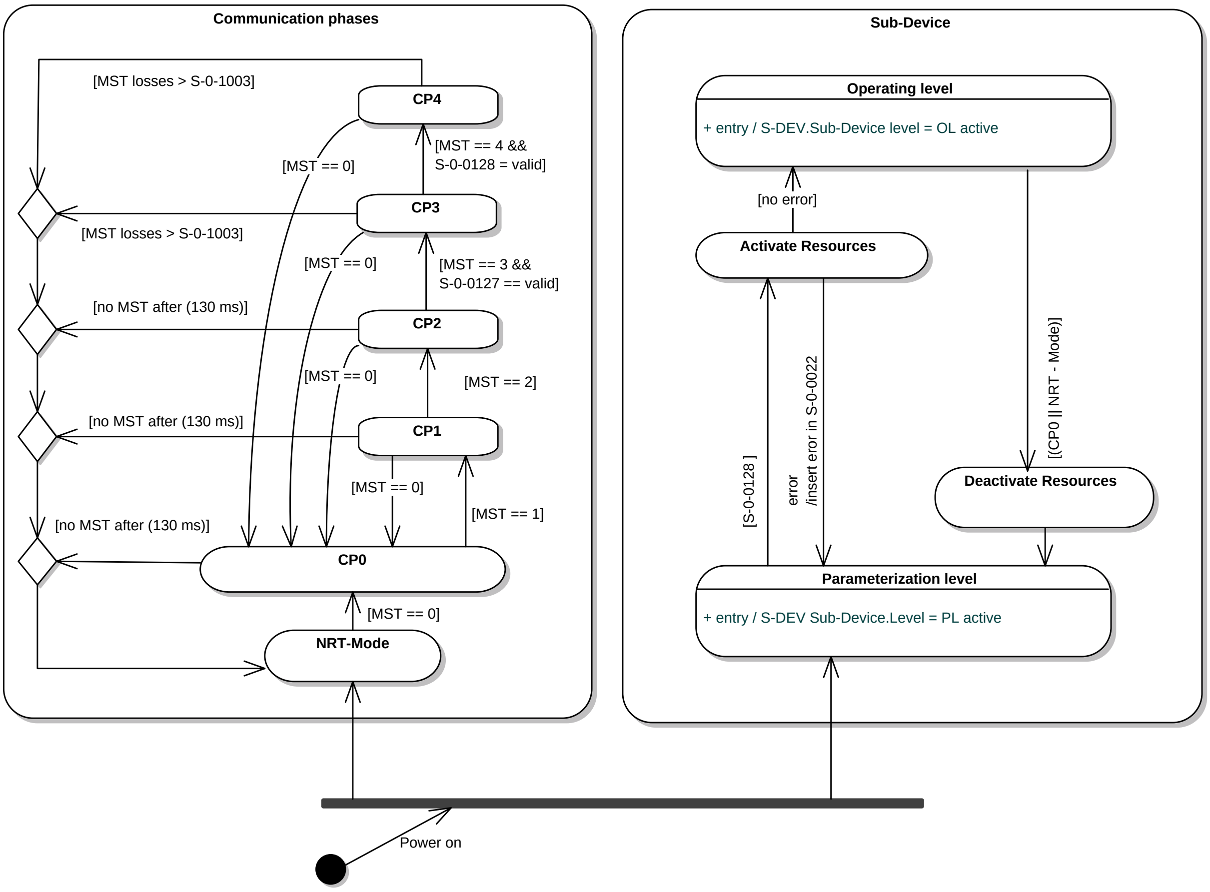

Légende

Anglais	Français
Communication phases	Phases de communication
Sub-device	Sous-appareil
MST losses	Pertes MST
Valid	Valide
Operating level	Niveau de fonctionnement
Entry	Entrée
S-DEV Sub-device level = OL active	S-DEV niveau de sous-appareil = OL active
No error	Pas d'erreur
Activate resources	Activation des ressources
No MST after (130 ms)	Pas de MST après (130 ms)
Error	Erreur
Insert error in S-0-0022	Insérer erreur dans S-0-0022
CP0 II – NRT – Mode)	(CP0 II Mode NRT)
Deactivate resources	Désactivation des ressources
Parameterization level	Niveau de paramétrage
NRT mode	Mode NRT
S-DEV Sub-device level = PL active	S-DEV niveau de sous-appareil = PL active
Power on	Mise sous tension

Figure C.1 – Diagramme d'états sans classe GDP_StM

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Sans la prise en charge de la classe "GDP_StM", le niveau de paramétrage devient actif:

- Après un redémarrage de l'esclave.
- Avec une entrée dans le mode NRT ou la phase CP0.

Sans la prise en charge de la classe "GDP_StM", le niveau de fonctionnement devient actif:

- Avec l'exécution réussie de la commande de procédure S-0-128 Contrôle de transition CP4.

C.2.5.2 Diagrammes d'états découplés

C.2.5.2.1 Présentation générale

Les paramètres du groupe de fonctions "Diagramme d'états" ont pour objectif de fournir une interface qui contrôle le diagramme d'états de sous-appareil indépendamment du diagramme d'états de communication (voir Figure C.2). Les IDN suivants sont définis dans ce groupe de fonctions:

- Un IDN pour l'activation du niveau de paramétrage (S-0-0420 Activer la commande de procédure du niveau de paramétrage (PL))
- Un IDN pour l'activation du niveau de fonctionnement (S-0-0422 Quitter la commande de procédure du niveau de paramétrage)
- Un IDN pour le gestion des erreurs pendant l'activation du niveau de fonctionnement (S-0-0423 Liste des IDN des données invalides pour le niveau de paramétrage)
- Un IDN de contrôle du couplage et découplage du diagramme d'états de communication et de sous-appareil (S-0-0425 Contrôle de diagramme d'états de sous-appareil)

L'esclave peut créer cette interface en prenant en charge la classe "GDP_StM".

Afin de contrôler le diagramme d'états du sous-appareil, indépendamment du diagramme d'états de communication, il faut que les commandes suivantes soient exécutées:

- S-0-0420 Activer la commande de procédure de niveau de paramétrage (PL)
- S-0-0422 Quitter la commande de procédure de niveau de paramétrage

Afin de vérifier si un changement du diagramme d'états de communication entraîne ou non une transition du diagramme d'états de sous-appareil, S-0-0425 Contrôle de diagramme d'états de sous-appareil est utilisé.

La Figure suivante présente de quelle manière les IDN, définis dans le groupe de fonctions "Diagramme d'états", contrôlent le diagramme d'états de sous-appareil.

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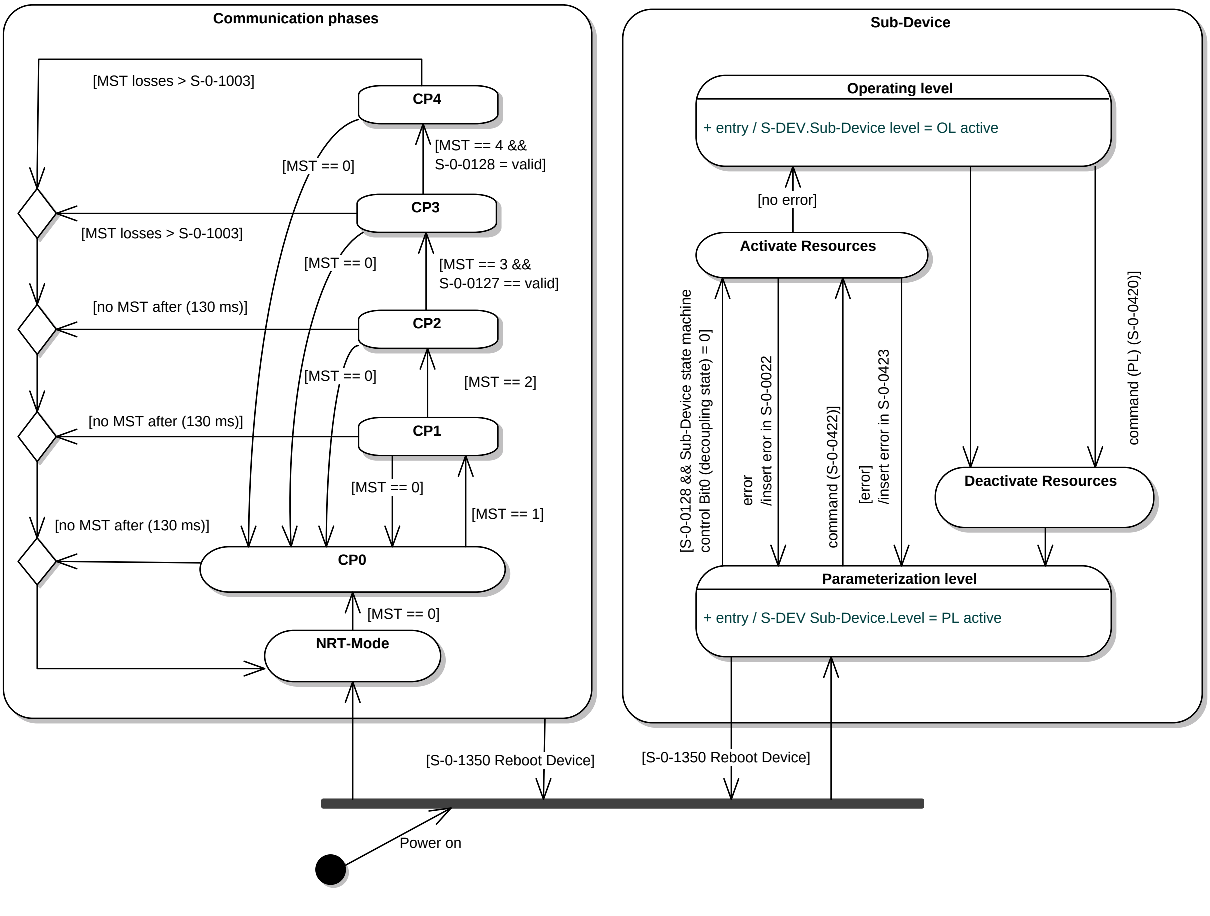

Légende

Anglais	Français
Communication phases	Phases de communication
Sub-device	Sous-appareil
MST losses	Pertes MST
Valid	Valide
Operating level	Niveau de fonctionnement
Entry	Entrée
S-DEV Sub-device level = OL active	S-DEV niveau de sous-appareil = OL active
No error	Pas d'erreur
Activate resources	Activation des ressources
No MST after (130 ms)	Pas de MST après (130 ms)
Error	Erreur
Insert error in S-0-0022	Insérer erreur dans S-0-0022
CP0 II – NRT – Mode)	(CP0 II Mode NRT)
Deactivate resources	Désactivation des ressources
Parameterization level	Niveau de paramétrage
NRT mode	Mode NRT
Power on	Mise sous tension
Sub-device state machine	Diagramme d'états de sous-appareil
Control Bit0 (decoupling state)	Bit0 de contrôle (état de découplage)
Command	Commande

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Anglais	Français
Insert error in S-0-00423	Insérer erreur dans S-0-00423
S-DEV Sub-device level = PL active	S-DEV niveau de sous-appareil = PL active
Reboot device	Redémarrage de l'appareil

Figure C.2 – Diagramme d'états sans classe GDP_StM

Les cas d'utilisation suivants sont possibles en prenant en charge la classe "GDP_StM".

C.2.5.2.2 Nouveau paramétrage pendant le transfert de données en temps réel

La commande de procédure S-0-0420 Activer la commande de procédure de niveau de paramétrage (PL) permet de modifier les paramètres protégés en écriture au niveau de fonctionnement et dont la protection en écriture est liée au diagramme d'états de sous-appareil, sans quitter la phase de communication CP3/CP4. Ceci peut être utile s'il faut que les paramètres spécifiques à l'application d'un sous-appareil spécifique soient ajustés alors que les applications des autres esclaves connectés demeurent activées.

Pour pouvoir quitter le niveau de fonctionnement, il faut que le maître active la commande de procédure S-0-0420 Activer la commande de procédure du niveau de paramétrage (PL) du sous-appareil. Après exécution de la commande de procédure, le sous-appareil interrompt son application et commute en interne sur le niveau de paramétrage, dans lequel est maintenue la communication de la phase active. Lorsque le sous-appareil est au niveau de paramétrage, le maître est capable de modifier les paramètres accessibles en écriture dans la phase de communication actuelle et au niveau PL. Après configuration des paramètres, le maître peut réactiver l'application du sous-appareil par l'exécution de la commande de procédure S-0-0422 Quitter la commande de procédure du niveau de paramétrage.

C.2.5.2.3 Prévention d'activation d'application

Dans certains cas (par exemple pendant la mise en service), il peut ne pas être possible d'exécuter l'application d'un sous-appareil spécifique. Dans ce cas, une commutation sur CP4 sans la prise en charge de la classe "GDP_StM" n'est pas possible, dans la mesure où la commande de procédure S-0-0128 Contrôle de transition CP4 qui, entre autres tâches, vérifie si l'application est prête à fonctionner, échouerait.

Le sous-appareil, en prenant en charge la classe "GDP_StM", permet de prévenir de manière explicite la commutation sur le niveau de fonctionnement et permet par conséquent la commutation d'une phase de communication sur CP4 avec une application désactivée. Ce comportement est le résultat du réglage du bit 0 (état de découplage) de S-0-0425 Contrôle du diagramme d'états de sous-appareil sur 1 (découplé), avant l'exécution de la commande de procédure S-0-0128 Contrôle de transition CP4.

Si la commande de procédure S-0-0128 Contrôle de transition CP4 est exécutée et si le bit 0 de S-0-0425 Contrôle de diagramme d'états de sous-appareil est défini, l'exécution de S-0-0128 Contrôle de transition CP4 est effectuée dans le sous-appareil sans aucune vérification et génère un acquittement positif.

C.2.5.2.4 Exécution précoce de l'application

Dans certaines situations (par exemple, lors de la mise en service) où une communication cyclique (phases de communication CP3 et CP4) est impossible, il est requis d'accéder à une application d'exécution dans le sous-appareil via la SVC ou le S/IP afin de soumettre à essai les sous-fonctions de l'application. La prise en charge de la classe "GDP_StM" permet à l'utilisateur d'activer l'application dans l'appareil avant l'activation implicite de l'application à l'aide de la commande de procédure S-0-0128 Contrôle de transition CP4.

L'activation précoce de l'application s'effectue par l'exécution de la commande de procédure S-0-0422 Quitter la commande de procédure de niveau de paramétrage dans les phases de

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communication précédentes (mode NRT-CP3, généralement CP2). Une fois activée l'application préalablement au Contrôle de transition CP4 (S-0-0128), le diagramme d'états du sous-appareil est déjà activé, et l'exécution du Contrôle de transition CP4 (S-0-0128) est ainsi effectuée dans le sous-appareil sans aucune vérification. Dans ce cas, la commande de procédure S-0-0128 Contrôle de transition CP4, génère un acquittement positif.

C.2.5.2.5 Poursuite du niveau de fonctionnement

Certaines applications exigent un état de fonctionnement continu d'esclaves spécifiques, indépendamment de la phase de communication actuelle. En prenant en charge la classe "GDP_StM", le sous-appareil permet de maintenir l'application en fonctionnement malgré la commutation de la phase de communication sur une phase de communication inférieure (par exemple, mode NRT, CP0).

Afin de maintenir l'application en fonctionnement, indépendamment des changements de phase de communication, il est nécessaire de régler S-0-0425 Bit0 de contrôle de diagramme d'états de sous-appareil (état de découplage) sur 1 (découplé).

Ce groupe de fonctions inclut les IDN suivants:

- S-0-0420 Activer la commande de procédure de niveau de paramétrage (PL)
- S-0-0422 Quitter la commande de procédure de niveau de paramétrage
- S-0-0423 Liste des IDN de données invalides pour le niveau de paramétrage
- S-0-0425 Contrôle de diagramme d'états de sous-appareil
- S-0-1350.0.1 Retard de l'appareil de redémarrage
- S-0-1350 Appareil de redémarrage

et les bits de commande et d'état suivants

- S-DEV/Niveau de sous-appareil

C.2.6 Groupe de fonctions Durée

Ce groupe de fonctions décrit la transmission et l'activation de l'heure de Type 19 dans l'esclave, par rapport à l'heure actuelle dans le maître. Le maître doit calculer une durée prévisible (prévision) afin de compenser le retard de transmission.

Le paramètre S-0-1305.0.01 contient l'heure de Type 19 actuelle au format de la CEI 61588. Le sous-appareil peut marquer les événements avec cette durée (par exemple, S-0-1305.0.01 marque les traces de diagnostic avec des datations).

Ce groupe de fonctions inclut les IDN suivants:

- S-0-1305.0.01 Heure actuelle de Type 19
- S-0-1305.0.02 Heure précise actuelle de Type 19

C.2.7 Groupe de fonctions Essai de conformité GDP

Ce groupe de fonctions contient les IDN exigés par l'essai de conformité.

Les IDN suivants ne doivent pas figurer dans les données d'exploitation de S-0-0017 (Liste des IDN de toutes les données d'exploitation)

- S-0-1399.0.1 Evènement de diagnostic des IDN d'essai

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C.3 Classification

C.3.1 Généralités

Plusieurs classes GDP peuvent être mises en œuvre par les sous-appareils.

La classe GDP définit une classe (GDP Basic) qui fournit les fonctionnalités minimales nécessaires dans un sous-appareil au niveau de l'application. La classe GDP Basic doit être mise en œuvre par tous les sous-appareils.

Les autres classes GDP peuvent être mises en œuvre au-dessus d'elles.

C.3.2 GDP_Basic

Les IDN suivants sont essentiels pour le profil d'appareil générique. Chaque appareil de Type 19 doit contenir ces paramètres.

Cette classe inclut les IDN suivants:

- S-0-0017 Liste des IDN de toutes les données d'exploitation
- S-0-0099 Diagnostic de classe 1 de réinitialisation
- S-0-0390 Numéro de diagnostic
- S-0-1300.x.03 Code fournisseur
- S-0-1300.x.05 ID d'appareil du fournisseur
- S-0-1301 Liste des classes & Version GDP
- S-0-1302.x.01 Type & Version FSP
- S-0-1302.x.02 Groupes de fonctions

La DEL de Type 19 ne fait pas partie de la classe GDP_Basic, mais doit toutefois être mise en œuvre, voir FG Diagnostic.

C.3.3 GDP_DiagT

Les IDN suivants sont essentiels pour le profil d'appareil générique, classe Trace de diagnostic. Lorsque cette classe est annoncée, le sous-appareil doit mettre en œuvre ce paramètre et les fonctions dédiées.

Cette classe inclut les IDN suivants:

- S-0-1303.0.02 Déclaration de trace de diagnostic
- S-0-1303.0.03 Etat de trace de diagnostic
- S-0-1303.0.10 Mémoire tampon de trace de diagnostic n°1
- S-0-1303.0.11 Mémoire tampon de trace de diagnostic n°2
- S-0-1305.0.01 Heure actuelle de Type 19

C.3.4 GDP_DiagTAdv

Les IDN suivants sont essentiels pour le profil d'appareil générique, classe Trace de diagnostic avancée. Cette classe exige la mise en œuvre de la classe GDP_DiagT. Lorsque cette classe est annoncée, le sous-appareil doit mettre en œuvre ce paramètre et les fonctions dédiées.

Cette classe inclut les IDN suivants:

- S-0-1303.0.01 Configuration de trace de diagnostic

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- S-0-1303.0.12 Mémoire tampon de trace de diagnostic n°3

C.3.5 GDP_LNg

Les IDN suivants sont essentiels pour le profil d'appareil générique, classe LaNguage. Lorsque cette classe est annoncée, le sous-appareil doit mettre en œuvre ce paramètre et les fonctions dédiées.

Cette classe inclut les IDN suivants:

- S-0-0265 Choix de la langue
- S-0-0266 Liste des langues disponibles

C.3.6 GDP_PWD

Les IDN suivants sont essentiels pour le profil d'appareil générique, classe PassWorD. Lorsque cette classe est annoncée, le sous-appareil doit mettre en œuvre ce paramètre et les fonctions dédiées.

Cette classe inclut les IDN suivants:

- S-0-0267 Mot de passe
- S-0-0279 Liste des IDN de données protégées par mot de passe

C.3.7 GDP_Id

Les IDN suivants sont essentiels pour le profil d'appareil générique, classe Identification. Lorsque cette classe est annoncée, le sous-appareil doit mettre en œuvre ce paramètre et les fonctions dédiées.

Cette classe inclut les IDN suivants:

- S-0-1300.x.01 Nom de composant
- S-0-1300.x.02 Nom du fournisseur
- S-0-1300.x.04 Nom d'appareil
- S-0-1300.x.11 Numéro de commande
- S-0-1300.x.12 Numéro de série
- S-0-1302.x.03 Type d'application

C.3.8 GDP_Rev

Les IDN suivants sont essentiels pour le profil d'appareil générique, classe Révisions. Lorsque cette classe est annoncée, le sous-appareil doit mettre en œuvre ce paramètre et les fonctions dédiées.

Cette classe inclut les IDN suivants:

- S-0-1300.x.07 Révision des fonctions
- S-0-1300.x.08 Révision du matériel
- S-0-1300.x.09 Révision du logiciel
- S-0-1300.x.10 Révision du chargeur de micrologiciel

C.3.9 GDP_QA

Les IDN suivants sont essentiels pour le profil d'appareil générique, classe Assurance qualité. Lorsque cette classe est annoncée, le sous-appareil doit mettre en œuvre ce paramètre et les fonctions dédiées.

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Cette classe inclut les IDN suivants:

- S-0-1300.x.13 Date de construction
- S-0-1300.x.14 Date AQ
- S-0-1300.x.21 Date de service
- S-0-1300.x.22 Date d'étalonnage
- S-0-1300.x.23 Date limite d'étalonnage

C.3.10 GDP_CKs

Les IDN suivants sont essentiels pour le profil d'appareil générique, classe Somme de contrôle. Lorsque cette classe est annoncée, le sous-appareil doit mettre en œuvre ce paramètre et les fonctions dédiées.

Cette classe inclut les IDN suivants:

- S-0-0192 Liste des IDN de toutes les données d'exploitation de sauvegarde
- S-0-0531 Somme de contrôle relative aux données d'exploitation de sauvegarde

C.3.11 GDP_CKsUser

Les IDN suivants sont essentiels pour le profil d'appareil générique, classe ChecKsumsUser. Cette classe exige la mise en œuvre de la classe GDP_CKs. Lorsque cette classe est annoncée, le sous-appareil doit mettre en œuvre ce paramètre et les fonctions dédiées. Ces paramètres peuvent être instanciés au moyen des instances (SI).

Cette classe inclut les IDN suivants:

- S-0-0326.x.0 Somme de contrôle des paramètres
- S-0-0327.x.0 Liste des IDN du paramètre de somme de contrôle

C.3.12 GDP_StM

Les IDN suivants sont essentiels pour le profil d'appareil générique, classe StateMachine. Lorsque cette classe est annoncée, le sous-appareil doit mettre en œuvre ce paramètre et les fonctions dédiées.

Cette classe inclut les IDN suivants:

- S-0-0420 Activer la commande de procédure de niveau de paramétrage (PL)
- S-0-0422 Quitter la commande de procédure de niveau de paramétrage
- S-0-0423 Liste des IDN de données invalides pour le niveau de paramétrage
- S-0-0425 Contrôle de diagramme d'états de sous-appareil

C.3.13 GDP_BKP

Les IDN suivants sont essentiels pour le profil d'appareil générique, classe BacKuP. Lorsque cette classe est annoncée, le sous-appareil doit mettre en œuvre ce paramètre et les fonctions dédiées.

Cette classe inclut les IDN suivants:

- S-0-0192 Liste des IDN de toutes les données d'exploitation de sauvegarde
- S-0-0262 Commande de procédure de défauts de charge
- S-0-0263 Commande de procédure de mémoire de travail de charge
- S-0-0264 Commande de procédure de mémoire de travail de sauvegarde

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- S-0-0531 Somme de contrôle relative aux données d'exploitation de sauvegarde

C.3.14 GDP_BKPAdv

Les IDN suivants sont essentiels pour le profil d'appareil générique, classe BacKuPAdvance. Cette classe exige la mise en œuvre de la classe GDP_BKP. Lorsque cette classe est annoncée, le sous-appareil doit mettre en œuvre ce paramètre et les fonctions dédiées.

Cette classe inclut les IDN suivants:

- S-0-0270 Liste des IDN de données d'exploitation de sauvegarde sélectionnées
- S-0-0293 Commande de procédure de mémoire de travail de sauvegarde sélectionnée
- S-0-1310 Liste des IDN de données d'exploitation différentes des données par défaut

C.3.15 GDP_RST

Les IDN suivants sont essentiels pour le profil d'appareil générique, classe Redémarrage (Restart). Lorsque cette classe est annoncée, le sous-appareil doit mettre en œuvre ce paramètre et les fonctions dédiées.

Cette classe inclut les IDN suivants:

- S-0-1350 Appareil de redémarrage

C.3.16 GDP_CIPSafetyDev

Les IDN suivants sont essentiels pour le profil d'appareil générique, classe CIP_SafetyDev. Lorsque cette classe est annoncée, le sous-appareil doit mettre en œuvre ce paramètre et les fonctions dédiées.

C.4 Liste de tous les IDN associés au GDP

C.4.1 Spécification des IDN

Voir l'Article A.1.

C.4.2 Numéros d'identification par ordres numériques

Le Tableau C.3 énumère les IDN associés au GDP, que les appareils de ce type doivent par ailleurs prendre en charge.

Le contenu des données spécifiques à l'application est spécifié dans d'autres normes correspondantes, par exemple CEI 61800-7-20x.

Tableau C.3 – Liste des IDN de communication appropriés

N° IDN	Nom
S-0-0000	IDN fictif
S-0-0017	Liste des IDN de toutes les données d'exploitation
S-0-0025	Liste des IDN de toutes les commandes de procédure
S-0-0095	Message de diagnostic
S-0-0099	Diagnostic de classe de réinitialisation 1
S-0-0192	Liste des IDN de toutes les données d'exploitation de sauvegarde
S-0-0262	Commande de procédure de défauts de charge
S-0-0263	Commande de procédure de mémoire de travail de charge

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N° IDN	Nom
S-0-0264	Commande de procédure de mémoire de travail de sauvegarde
S-0-0265	Choix de la langue
S-0-0266	Liste des langues disponibles
S-0-0267	Mot de passe
S-0-0269	Mode d'archivage
S-0-0270	Liste des IDN de données d'exploitation de sauvegarde sélectionnées
S-0-0279	Liste des IDN de données protégées par mot de passe
S-0-0293	Commande de procédure de mémoire de travail de sauvegarde sélectionnée
S-0-0326.x.0	Somme de contrôle des paramètres
S-0-0327.x.0	Liste des IDN de somme de contrôle des paramètres
S-0-0390	Numéro de diagnostic
S-0-0420	Activer la commande de procédure de niveau de paramétrage (PL)
S-0-0422	Quitter la commande de procédure de niveau de paramétrage
S-0-0423	Liste des IDN de données invalides pour le niveau de paramétrage
S-0-0425	Contrôle de diagramme d'états de sous-appareil
S-0-0531	Somme de contrôle relative aux données d'exploitation de sauvegarde
S-0-1300.x.1	Nom de composant
S-0-1300.x.2	Nom du fournisseur
S-0-1300.x.3	Code fournisseur
S-0-1300.x.4	Nom d'appareil
S-0-1300.x.5	ID d'appareil du fournisseur
S-0-1300.x.6	Connecté au sous-appareil
S-0-1300.x.7	Révision des fonctions
S-0-1300.x.8	Révision du matériel
S-0-1300.x.9	Révision du logiciel
S-0-1300.x.10	Révision du chargeur de micrologiciel
S-0-1300.x.11	Numéro de commande
S-0-1300.x.12	Numéro de série
S-0-1300.x.13	Date de construction
S-0-1300.x.14	Date AQ
S-0-1300.x.20	Heures de fonctionnement
S-0-1300.x.21	Date de service
S-0-1300.x.22	Date d'étalonnage
S-0-1300.x.23	Date limite d'étalonnage
S-0-1301	Liste des groupes de fonctions & Version GDP
S-0-1302.x.1	Type & Version FCP
S-0-1302.x.2	Groupes de fonctions
S-0-1302.x.3	Type d'application
S-0-1303.0.1	Configuration de trace de diagnostic
S-0-1303.0.2	Déclaration de trace de diagnostic
S-0-1303.0.3	Etat de trace de diagnostic
S-0-1303.0.10	Mémoire tampon de trace de diagnostic n°1
S-0-1303.0.11	Mémoire tampon de trace de diagnostic n°2

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N° IDN	Nom
S-0-1303.0.12	Mémoire tampon de trace de diagnostic n°3
S-0-1305.0.1	Heure actuelle
S-0-1305.0.2	Heure précise actuelle
S-0-1310	Liste des IDN de données d'exploitation différentes des données par défaut
S-0-1399	Evènement de diagnostic des IDN d'essai

C.4.3 Spécification détaillée des IDN de communication

C.4.3.1 IDN S-0-0000 IDN fictif

C.4.3.1.1 Attributs

Le Tableau C.4 présente les attributs potentiels pour cet IDN.

Tableau C.4 – Attributs de l'IDN S-0-0000

Attribut	Valeur
Nom	IDN fictif
Version	—
Longueur	2
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Jamais
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.1.2 Description

Ce paramètre peut être utilisé comme

- paramètre fictif dans une liste de configuration IDN
- paramètre fictif de deux octets dans une connexion
- afin d'interrompre les fonctions attribuées

C.4.3.2 IDN S-0-0017 Liste des IDN de toutes les données d'exploitation

C.4.3.2.1 Attributs

Le Tableau C.5 présente les attributs potentiels pour cet IDN.

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Tableau C.5 – Attributs de l'IDN S-0-0017

Attribut	Valeur
Nom	Liste des IDN de toutes les données d'exploitation
Version	—
Longueur	4, variable (liste triée par IDN)
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.2.2 Description

Tous les IDN de toutes les commandes et de tous les paramètres de procédure du sous-appareil sont archivés dans cette liste des IDN.

C.4.3.3 IDN S-0-0025 Liste des IDN de toutes les commandes de procédure

C.4.3.3.1 Attributs

Le Tableau C.6 présente les attributs potentiels pour cet IDN.

Tableau C.6 – Attributs de l'IDN S-0-0025

Attribut	Valeur
Nom	Liste des IDN de toutes les commandes de procédure
Version	—
Longueur	4, variable (liste triée par IDN)
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.3.2 Description

Les IDN de toutes les commandes de procédure sont archivés dans cette liste des IDN.

C.4.3.4 IDN S-0-0095 Message de diagnostic

C.4.3.4.1 Attributs

Le Tableau C.7 présente les attributs potentiels pour cet IDN.

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Tableau C.7 – Attributs de l'IDN S-0-0095

Attribut	Valeur
Nom	Message de diagnostic
Version	—
Longueur	1, variable
Format d'affichage	Texte
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.4.2 Description

Les messages de diagnostic permettent de contrôler l'état de fonctionnement actuellement valide. Les messages de diagnostic sont générés par l'esclave sous forme de texte et archivés dans les données d'exploitation de cet IDN.

C.4.3.5 IDN S-0-0099 Diagnostic de classe 1 de réinitialisation

C.4.3.5.1 Attributs

Le Tableau C.8 présente les attributs potentiels pour cet IDN.

Tableau C.8 – Attributs de l'IDN S-0-0099

Attribut	Valeur
Nom	Diagnostic de classe de réinitialisation 1
Version	—
Longueur	2
Format d'affichage	Binaire
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.5.2 Description

Si cette commande de procédure est reçue par le sous-appareil via la voie de service, tous les événements de diagnostic avec la classe "erreur" (C1D), les bits d'erreur et le mécanisme d'arrêt sont supprimés. Si l'origine d'un événement de diagnostic avec la classe "erreur" est toujours active, l'événement correspondant est alors généré une nouvelle fois. Ainsi, il faut qu’une entrée supplémentaire dédiée à cet événement dans la trace de diagnostic soit générée.

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Cette commande de procédure ne peut pas être interrompue, et ne génère aucun acquittement négatif, même lorsqu'une erreur ne peut être supprimée ou le sous-appareil ne comporte aucune erreur.

C.4.3.6 IDN S-0-0192 Liste des IDN de toutes les données d'exploitation de sauvegarde

C.4.3.6.1 Attributs

Le Tableau C.9 présente les attributs potentiels pour cet IDN.

Tableau C.9 – Attributs de l'IDN S-0-0192

Attribut	Valeur
Nom	Liste des IDN de toutes les données d'exploitation de sauvegarde
Version	—
Longueur	4, variable (liste triée par IDN)
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.6.2 Description

La liste des IDN archive les IDN de tous les paramètres d'appareil devant être chargés dans l'appareil afin de garantir un fonctionnement correct. Le maître utilise cette liste pour générer une copie de sauvegarde des paramètres d'appareil.

C.4.3.7 IDN S-0-0262 Commande de procédure de défauts de charge

C.4.3.7.1 Attributs

Le Tableau C.10 présente les attributs potentiels pour cet IDN.

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Tableau C.10 – Attributs de l'IDN S-0-0262

Attribut	Valeur
Nom	Commande de procédure de défauts de charge
Version	—
Longueur	2
Format d'affichage	Binaire
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	OL
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.7.2 Description

Lorsque le maître définit et active la commande de procédure de défauts de charge, les valeurs des paramètres par défaut sont activées. La portée et le contenu des valeurs des paramètres par défaut (par exemple, valeurs limites, paramètres de boucle de vitesse, etc.) sont déterminés par le fournisseur de l'appareil. Les valeurs des paramètres par défaut ne sont pas optimisées pour l'application respective. Ces valeurs permettent par conséquent un fonctionnement interne sans problème entre le sous-appareil et ses composants connectés.

C.4.3.8 IDN S-0-0263 Commande de procédure de mémoire de travail de charge

C.4.3.8.1 Attributs

Le Tableau C.11 présente les attributs potentiels pour cet IDN.

Tableau C.11 – Attributs de l'IDN S-0-0263

Attribut	Valeur
Nom	Commande de procédure de mémoire de travail de charge
Version	—
Longueur	2
Format d'affichage	Binaire
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	OL
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.8.2 Description

Lorsque le maître définit et active la commande de procédure de mémoire de travail de charge, toutes les données nécessaires au fonctionnement (voir S-0-0192) sont chargées de la mémoire non volatile de l'appareil dans sa "mémoire active". Après mise sous tension,

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l'appareil transfère automatiquement les données de la mémoire non volatile dans la mémoire active.

NOTE Cette commande de procédure entraîne la réécriture des paramètres actifs.

C.4.3.9 IDN S-0-0264 Commande de procédure de mémoire de travail de sauvegarde

C.4.3.9.1 Attributs

Le Tableau C.12 présente les attributs potentiels pour cet IDN.

Tableau C.12 – Attributs de l'IDN S-0-0264

Attribut	Valeur
Nom	Commande de procédure de mémoire de travail de sauvegarde
Version	—
Longueur	2
Format d'affichage	Binaire
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Jamais
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.9.2 Description

Lorsque le maître définit et active la commande de procédure de mémoire de travail de sauvegarde, toutes les données nécessaires au fonctionnement (voir S-0-0192) sont chargées de la "mémoire active" de l'appareil dans sa mémoire non volatile.

NOTE Cette commande de procédure entraîne la réécriture des paramètres sauvegardés précédemment.

C.4.3.10 IDN S-0-0265 Choix de la langue

C.4.3.10.1 Attributs

Le Tableau C.13 présente les attributs potentiels pour cet IDN.

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Tableau C.13 – Attributs de l'IDN S-0-0265

Attribut	Valeur
Nom	Choix de la langue
Version	—
Longueur	2
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Jamais
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.10.2 Description

Ce paramètre permet de sélectionner une des langues disponibles dans l'appareil (voir S-0-0266). En modifiant le choix de la langue, le texte contenu dans l'appareil tel que

- Nom (élément 2)
- Unité (élément 4) et
- tous les paramètres avec le type de donnés et le format d'affichage = texte (par exemple, S-0-0095)

s'affiche dans la langue choisie (voir Tableau C.14).

Tableau C.14 – Codes de la langue

Valeur	Langue
0	Allemand
1	Anglais
2	Français
3	Espagnol
4	Italien
5	Portugais
6	Polonais
7	Hongrois
8	Russe
9	Suédois
10	Danois
11	Norvégien
12-65535	(réservé)

C.4.3.11 IDN S-0-0266 Liste des langues disponibles

C.4.3.11.1 Attributs

Le Tableau C.15 présente les attributs potentiels pour cet IDN.

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Tableau C.15 – Attributs de l'IDN S-0-0266

Attribut	Valeur
Nom	Liste des langues disponibles
Version	—
Longueur	2, variable
Format d'affichage	Décimale non signée (codes de langues, voir S-0-0165)
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.11.2 Description

Cette liste contient les codes de toutes les langues actuellement disponibles dans l'appareil, dédiés au choix de la langue (voir S-0-0265). Cette liste est requise lorsque l'appareil ne peut pas gérer ou sauvegarder simultanément toutes les langues dans sa mémoire.

C.4.3.12 IDN S-0-0267 Mot de passe

C.4.3.12.1 Attributs

Le Tableau C.16 présente les attributs potentiels pour cet IDN.

Tableau C.16 – Attributs de l'IDN S-0-0267

Attribut	Valeur
Nom	Mot de passe
Version	—
Longueur	1, variable
Format d'affichage	Texte
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Jamais
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.12.2 Description

Ce paramètre permet de protéger en écriture les paramètres choisis de l'appareil, à l'aide d'un mot de passe.

Les paramètres, concernés par ce type de protection en écriture, sont énumérés dans S-0-0279 Liste des IDN des données protégées par mot de passe.

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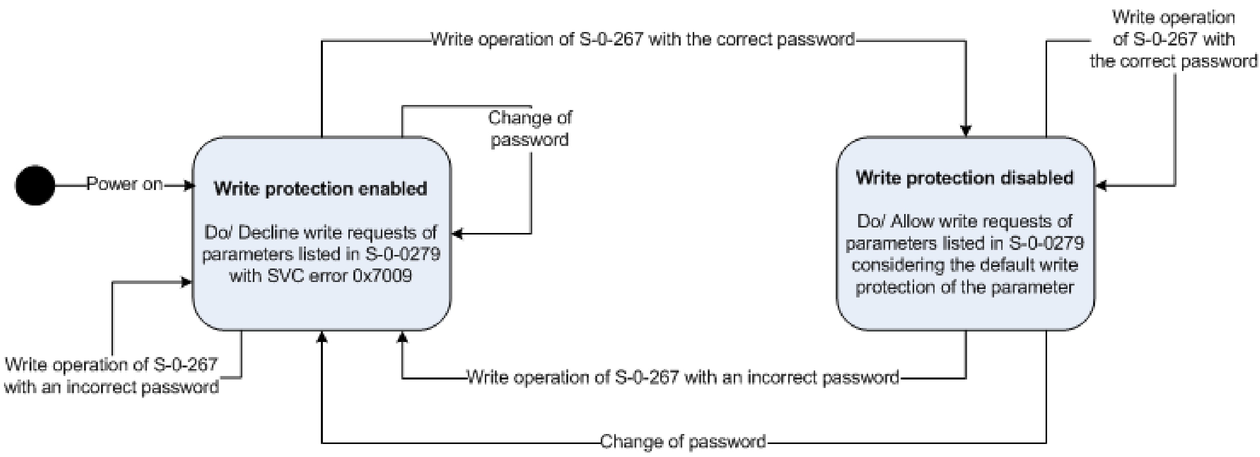
Le mot de passe, utilisé pour la protection en écriture, régit les règles suivantes:

- il doit comporter uniquement les caractères UTF8
- les espaces (code UTF8 0x20) ne sont pas admis
- la reconnaissance des caractères est sensible à la casse

Le diagramme d'états de la protection en écriture de tous les paramètres protégés par mot de passe est illustré à la Figure C.3.



Légende

Anglais	Français
Write operation of S-0-267 with the correct password	Ecrire l'opération de S-0-267 avec le mot de passe correct
Change of password	Changement de mot de passe
Power on	Mise sous tension
Write protection enabled	Protection en écriture activée
Do/Decline write requests of parameters listed in S-0-0279 with SVC error 0x7009	Réaliser/rejeter les demandes d'écriture des paramètres énumérés en S-0-0279 avec erreur SVC 0x7009
Write protection disabled	Protection en écriture désactivée
Do/Allow write requests of parameters listed in S-0-0279 considering the default write protection of the parameter	Réaliser/permettre les demandes d'écriture des paramètres énumérés en S-0-0279 en tenant compte de la protection en écriture par défaut du paramètre
Write operation of S-0-267 with an incorrect password	Ecrire l'opération de S-0-267 avec un mot de passe incorrect

Figure C.3 – Diagramme d'états des mots de passe

Les états peuvent être décrits comme suit (voir Tableau C.17):

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Tableau C.17 – Etats du diagramme d'états des mots de passe

Etat	Description
Protection en écriture activée	Les demandes en écriture des paramètres énumérés dans S-0-0279 Liste des IDN des données protégées par mot de passe et les demandes en écriture du paramètre S-0-0279 Liste des IDN des données protégées par mot de passe, sont rejetées avec l'erreur SVC 0x7009 - les données d'exploitation sont protégées en écriture par un mot de passe. Si les données d'exploitation de S-0-0267 Mot de passe, sont lues dans cet état, l'appareil ne renvoie pas le mot de passe sous forme de texte en clair. La chaîne "***" (code UTF8 0x2A) est transmise en lieu et place.
Protection en écriture désactivée	Les demandes en écriture des paramètres énumérés dans S-0-0279 Liste des IDN des données protégées par mot de passe, compte tenu de la protection en écriture par défaut du paramètre, sont possibles. Cela signifie qu'une demande en écriture d'un paramètre, qui est protégé en écriture en CP4 et énuméré dans S-0-0279 Liste des IDN des données protégées par mot de passe, est possible dans une phase de communication < CP4, mais échoue en phase CP4. Si les données d'exploitation de S-0-0267 Mot de passe, sont lues dans cet état, l'appareil ne renvoie pas le mot de passe sous forme de texte en clair. La chaîne "$$$" (code UTF8 0x24) est transmise en lieu et place.

Les transitions peuvent être décrites comme suit (voir Tableau C.18):

Tableau C.18 – Transitions du diagramme d'états des mots de passe

Transition			Description
Source	Cible	Condition	
Protection en écriture activée	Protection en écriture activée	Opération en écriture de S-0-0267 Mot de passe avec un mot de passe incorrect	L'envoi d'une demande en écriture des données d'exploitation de S-0-0267 Mot de passe avec un mot de passe incorrect dans l'état de protection en écriture spécifique au mot de passe activé, ne modifie pas la protection en écriture des paramètres énumérés dans S-0-0279 Liste des IDN des données protégées par mot de passe. La demande en écriture ne doit pas être rejetée par l'esclave avec une erreur SVC (par exemple 0x7008 (données d'exploitation invalides)), sauf lorsque les conditions aux limites de l'accès SVC (par exemple, longueur des données d'exploitation > longueur maximale) sont enfreintes.
Protection en écriture activée	Protection en écriture activée	Changement de mot de passe	Un changement de mot de passe (voir section ci-dessous) dans l'état de protection en écriture spécifique au mot de passe activé, ne modifie pas la protection en écriture des paramètres énumérés dans S-0-0279 Liste des IDN des données protégées par mot de passe.
Protection en écriture activée	Protection en écriture désactivée	Opération en écriture de S-0-0267 Mot de passe avec le mot de passe incorrect	L'envoi d'une demande en écriture des données d'exploitation de S-0-0267 Mot de passe avec le mot de passe correct (sensible à la casse), désactive la protection en écriture spécifique au mot de passe de tous les paramètres énumérés dans S-0-0279 Liste des IDN des données protégées par mot de passe.
Protection en écriture désactivée	Protection en écriture désactivée	Opération en écriture de S-0-0267 Mot de passe avec le mot de passe incorrect	L'envoi d'une demande en écriture des données d'exploitation de S-0-0267 Mot de passe avec le mot de passe correct dans l'état de protection en écriture spécifique au mot de passe désactivé, ne modifie pas la protection en écriture des paramètres énumérés dans S-0-0279 Liste des IDN des données protégées par mot de passe.
Protection en écriture désactivée	Protection en écriture activée	Changement de mot de passe	Un changement de mot de passe (voir section ci-dessous) active la protection en écriture spécifique au mot de passe de tous les paramètres énumérés dans S-0-0279 Liste des IDN des données protégées par mot de passe.
Protection en écriture désactivée	Protection en écriture activée	Opération en écriture de S-0-0267 Mot de passe avec un mot de passe incorrect	L'envoi d'une demande en écriture des données d'exploitation de S-0-0267 Mot de passe avec un mot de passe incorrect, active la protection en écriture spécifique au mot de passe de tous les paramètres énumérés dans S-0-0279 Liste des IDN des données protégées par mot de passe. La demande en écriture ne doit pas être rejetée par l'esclave avec une erreur SVC (par exemple 0x7008 (données d'exploitation invalides)), sauf lorsque les conditions aux limites de l'accès SVC (par

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Transition			Description
Source	Cible	Condition	
			exemple, longueur des données d'exploitation > longueur maximale) sont enfreintes.

Changement du mot de passe

Le changement du mot de passe nécessite de saisir le mot de passe actuel et le nouveau mot de passe, ainsi que de vérifier une seconde fois le nouveau mot de passe via la SVC (voir Tableau C.19).

Un caractère espace (code UTF8 0x20) permet de délimiter les mots de passe. Le nouveau mot de passe et la copie de vérification doivent correspondre pour permettre à l'appareil d'accepter la modification.

Tableau C.19 – Changement du mot de passe

1	2	3	4	5
mot de passe actuel	Espace (code UTF8 0x20)	Nouveau mot de passe	Espace (code UTF8 0x20)	Nouveau mot de passe

Si le nouveau mot de passe ne correspond pas à la copie de vérification, l'esclave doit rejeter la demande de changement avec l'erreur SVC 0x7008 - Données d'exploitation invalides.

Il faut que la valeur actuelle du mot de passe soit archivée dans la mémoire non volatile.

Dans le cas d'un mot de passe inconnu, un mot de passe maître conçu par le fournisseur doit permettre de désactiver la protection en écriture du mot de passe.

Ce mot de passe doit toujours être fourni comme mot de passe actuel, outre le mot de passe spécifié par l'utilisateur.

Le fournisseur de l'appareil doit joindre ce mot de passe ou un autre mot de passe dans la documentation d'accompagnement de l'appareil, de sorte que l'utilisateur puisse configurer son propre mot de passe.

C.4.3.13 IDN S-0-0269 Mode d'archivage

C.4.3.13.1 Attributs

Le Tableau C.20 présente les attributs potentiels pour cet IDN.

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Tableau C.20 – Attributs de l'IDN S-0-0269

Attribut	Valeur
Nom	Mode d'archivage
Version	—
Longueur	2
Format d'affichage	Binaire
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Spécifique au constructeur
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.13.2 Description

Le paramétrage du mode d'archivage (voir Tableau C.21) détermine si les données reçues par la voie de service (canal UC) sont archivées provisoirement (par exemple, dans une mémoire RAM), ou de façon permanente (par exemple, EEPROM). Les paramètres concernés par le paramétrage du mode d'archivage doivent être définis par le fournisseur de l'appareil dans la documentation d'accompagnement.

Tableau C.21 – Structure du mode d'archivage

Numéro de bit	Valeur	Description
15-1	—	(réservé)
0	—	Mode d'archivage
	0	Données archivées de façon permanente
	1	Données archivées de façon non permanente

C.4.3.14 IDN S-0-0270 Liste des IDN de données d'exploitation de sauvegarde sélectionnées

C.4.3.14.1 Attributs

Le Tableau C.22 présente les attributs potentiels pour cet IDN.

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Tableau C.22 – Attributs de l'IDN S-0-0270

Attribut	Valeur
Nom	Liste des IDN de données d'exploitation de sauvegarde sélectionnées
Version	—
Longueur	4, variable (liste triée par IDN)
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Jamais
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.14.2 Description

Cette liste des IDN permet de définir un sous-ensemble de la liste des IDN des données d'exploitation de sauvegarde (S-0-0192) qu'il convient d'archiver dans la mémoire non volatile du sous-appareil. La commande de procédure de mémoire de travail de sauvegarde sélectionnée (S-0-0293), archive uniquement les données d'exploitation de cette liste des IDN dans la mémoire non volatile.

C.4.3.14.3 IDN S-0-0279 Liste des IDN de données protégées par mot de passe

C.4.3.14.4 Attributs

Le Tableau C.23 présente les attributs potentiels pour cet IDN.

Tableau C.23 – Attributs de l'IDN S-0-0279

Attribut	Valeur
Nom	Liste des IDN de données protégées par mot de passe
Version	—
Longueur	4, variable (liste triée par IDN)
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Jamais
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.14.5 Description

Les données d'exploitation de cet IDN contiennent une liste des IDN, dont il convient que les données d'exploitation soient protégées en écriture par un mot de passe (S-0-0267).

Etant donné que cette liste des IDN ne doit pas être modifiée par un utilisateur non autorisé, il est nécessaire que cet IDN soit toujours protégé en écriture par un mot de passe (S-0-0267),

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que ce paramètre contienne ou non son propre IDN (S-0-0279), comme entrée de la liste des IDN.

C.4.3.15 IDN S-0-0293 Commande de procédure de mémoire de travail de sauvegarde sélectionnée

C.4.3.15.1 Attributs

Le Tableau C.24 présente les attributs potentiels pour cet IDN.

Tableau C.24 – Attributs de l'IDN S-0-0293

Attribut	Valeur
Nom	Commande de procédure de mémoire de travail de sauvegarde sélectionnée
Version	—
Longueur	2
Format d'affichage	Binaire
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Jamais
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.15.2 Description

Lorsque le maître définit et active la commande de procédure de mémoire de travail de sauvegarde sélectionnée, tous les paramètres programmés dans la liste des IDN des données d'exploitation de sauvegarde sélectionnées (S-0-0270) sont chargés de la "mémoire active" de l'appareil et archivés dans sa mémoire non volatile.

NOTE Cette commande de procédure entraîne la réécriture des paramètres sauvegardés précédemment.

C.4.3.16 IDN S-0-0326.x.00 Somme de contrôle des paramètres

C.4.3.16.1 Attributs

Le Tableau C.25 présente les attributs potentiels pour cet IDN.

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Tableau C.25 – Attributs de l'IDN S-0-0326.x.00

Attribut	Valeur
Nom	Somme de contrôle des paramètres
Version	—
Longueur	4
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.16.2 Description

Après mise sous tension, l'unité de commande est capable de déterminer par comparaison si les paramètres ou le micrologiciel ont été modifiés dans l'appareil. Ce dernier calcule la somme de contrôle des paramètres, lorsque l'IDN est lu via la voie de service.

Les paramètres énumérés dans la liste des IDN du paramètre de somme de contrôle (S-0-0327.x.0) permettent de calculer la somme de contrôle. Si l'appareil ne prend pas en charge S-0-0327.x.0, la liste des IDN S-0-0192 Liste des IDN de toutes les données d'exploitation de sauvegarde est utilisée pour le calcul de la somme de contrôle.

C.4.3.17 IDN S-0-0327.x.00 Liste des IDN du paramètre de somme de contrôle

C.4.3.17.1 Attributs

Le Tableau C.26 présente les attributs potentiels pour cet IDN.

Tableau C.26 – Attributs de l'IDN S-0-0327.x.00

Attribut	Valeur
Nom	Liste des IDN du paramètre de somme de contrôle
Version	—
Longueur	4, variable (liste triée par IDN)
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Jamais
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.17.2 Description

Cette liste des IDN contient tous les numéros d'identification pour le calcul de la somme de contrôle des paramètres. Voir S-0-0326.x.0 Somme de contrôle des paramètres.

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C.4.3.18 IDN S-0-0390 Numéro de diagnostic

C.4.3.18.1 Attributs

Le Tableau C.27 présente les attributs potentiels pour cet IDN.

Tableau C.27 – Attributs de l'IDN S-0-0390

Attribut	Valeur
Nom	Numéro de diagnostic
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Jamais
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.18.2 Description

Les données d'exploitation de cet IDN contiennent les informations détaillées concernant le diagnostic avec la priorité la plus élevée actuellement actif dans l'esclave ou le sous-appareil.

Afin que ces informations soient indépendantes de la langue, un code d'état à 16 bits est utilisé pour identifier le diagnostic spécifique. Avec ce code d'état, l'interface opérateur est capable d'afficher le texte du diagnostic dans des langues non prises en charge par le sous-appareil.

La hiérarchisation des diagnostics par ordre de priorité est décrite dans le Tableau C.28.

Tableau C.28 – Hiérarchisation des diagnostics par ordre de priorité

Classe de diagnostic (Bits 16-19)	Priorité	Indiqué (1)	Remplacé (2)
état de fonctionnement	Priorité 4 (niveau le moins élevé)	Tant que la présentation le requiert (par exemple, jusqu'à ce que les informations suivantes avec la classe "état de fonctionnement" remplacent les informations existantes).	Par d'autres informations de diagnostic avec une priorité plus élevée. Par des informations de diagnostic de même priorité, observée ultérieurement.
état spécifique à la commande de procédure	Priorité 3	Tant que la commande de procédure n'est pas réinitialisée par le maître.	Par d'autres informations de diagnostic avec une priorité plus élevée. Par des informations de diagnostic de même priorité, observée ultérieurement.
Avertissement (C2D)	Priorité 2	Tant que la menace correspondante est présente.	Par d'autres informations de diagnostic avec une priorité plus élevée.
erreur (C1D)	Priorité 1 (niveau le plus élevé)	Tant que le diagnostic de classe 1 de réinitialisation (S-0-0099) n'a pas été exécuté après élimination de la cause de la défaillance correspondante	-

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(1) Indiqué - Les informations de diagnostic font partie intégrante des données d'exploitation

(2) Remplacé - Les informations de diagnostic correspondantes sont remplacées par d'autres informations de diagnostic

Lorsqu'un diagnostic devient inactif et en l'absence d'autres diagnostics actifs, Il faut que les données d'exploitation de cet IDN contiennent le code d'état 0x0000.

Une synthèse de tous les codes d'état spécifiés est présentée dans l'IDN S-0-0390.

La structure du numéro de diagnostic est présentée dans le Tableau C.29.

Tableau C.29 – Transitions du diagramme d'états des mots de passe

Numéro de bit	Valeur	Description
31-30	—	Interprétation des bits 29-0 (Les bits 31-30 définissent l'interprétation du type de source, de la classe et des codes d'état des groupes.)
	00	codes d'état spécifiques au constructeur (type et classe des bits 29-24 définis par les codes d'état des bits 15-0 de Type 19, définis par le constructeur)
	01	entièrement spécifiques au constructeur (les bits 29-0 sont définis par le constructeur)
	10	(réservé)
	11	Standard (les bits 29-0 sont définis par le Type 19)
29-24	—	Type de source
	0x00	FSP Système d'entraînement
	0x01	FSP ES
	0x02	GDP
	0x03	SCP
	0X04	CSoS
	0x05	FSP codeur
	0x06	Application de sécurité
	0x07 … 0x3E	(réservé)
	0x3F	Non connu
23-20	—	(réservé)
19-16	—	Classe
	0x00-0x09	(réservé)
	0x0A	Etat de fonctionnement (priorité 4, niveau le moins élevé) - permet de renseigner l'utilisateur concernant les télégrammes liés à l'état de fonctionnement ou d'autres informations (par exemple, entraînement HALT, remplacement compatible).
	0x0B	(réservé)
	0x0C	état spécifique à la commande de procédure (priorité 3) - permet de renseigner l'utilisateur concernant les diagnostics qui interviennent lors de l'exécution d'une commande de procédure.
	0x0D	(réservé)
	0x0E	Avertissement (C2D) - Priorité 2
	0x0F	Erreur (C1D) - Priorité 1 (niveau le plus élevé)
15-00	—	Code d'état

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C.4.3.19 IDN S-0-0420 Activer la commande de procédure de niveau de paramétrage (PL)

C.4.3.19.1 Attributs

Le Tableau C.30 présente les attributs potentiels pour cet IDN.

Tableau C.30 – Attributs de l'IDN S-0-0420

Attribut	Valeur
Nom	Activer la commande de procédure de niveau de paramétrage (PL)
Version	—
Longueur	2
Format d'affichage	Binaire
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Jamais
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.19.2 Description

Par l'activation de cette commande de procédure, le maître indique au sous-appareil de passer du niveau de fonctionnement (OL) au niveau de paramétrage (PL).

Si la commande de procédure ne peut pas être exécutée à cet instant, le sous-appareil génère le message d'erreur SVC 0x7012 - "Commande de procédure actuellement non exécutable".

- L'esclave acquitte de manière positive la commande de procédure:
- Après découplage du diagramme d'états de sous-appareil du diagramme d'états de communication
- Le sous-appareil a activé le niveau PL
- Le bit 4 (niveau de sous-appareil) du mot d'état d'appareil a été réglé sur "1" (niveau de paramétrage (PL) actif).

C.4.3.20 IDN S-0-0422 Quitter la commande de procédure de niveau de paramétrage

C.4.3.20.1 Attributs

Le Tableau C.31 présente les attributs potentiels pour cet IDN.

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Tableau C.31 – Attributs de l'IDN S-0-0422

Attribut	Valeur
Nom	Quitter la commande de procédure de niveau de paramétrage
Version	—
Longueur	2
Format d'affichage	Binaire
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Jamais
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.20.2 Description

Par l'activation de cette commande de procédure, le maître indique au sous-appareil de passer du niveau de paramétrage (PL) au niveau de fonctionnement (OL).

Après activation de cette commande de procédure, l'esclave vérifie tous les paramètres correspondants et met tous les systèmes de surveillance sous tension. Les références nécessaires doivent être récupérées par l'unité de commande (par exemple, par ralliement).

Le sous-appareil acquitte de manière positive la commande de procédure:

- Après découplage du diagramme d'états de sous-appareil du diagramme d'états de communication
- Après que le sous-appareil a activé le niveau OL
- Le bit 4 (niveau de sous-appareil) du mot d'état d'appareil a été réglé sur "0" (niveau de fonctionnement (OL) actif).
- Lorsque tous les paramètres correspondants sont vérifiés sans révéler aucune anomalie
- Lorsque le système de surveillance a été mis sous tension

La commande de procédure est acquittée manière négative en cas d'anomalie détectée lors des vérifications. Dans ce cas, tous les IDN à l'origine d'une anomalie sont archivés dans la liste des IDN (S-0-0423) et le sous-appareil reste au niveau de paramétrage.

C.4.3.21 IDN S-0-0423 Liste des IDN de données invalides pour le niveau de paramétrage

C.4.3.21.1 Attributs

Le Tableau C.32 présente les attributs potentiels pour cet IDN.

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Tableau C.32 – Attributs de l'IDN S-0-0423

Attribut	Valeur
Nom	Liste des IDN de données invalides pour le niveau de paramétrage
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.21.2 Description

Cet IDN contient tous les IDN considérés comme invalides par le sous-appareil lors de l'exécution de la commande de procédure S-0-0422 (Quitter la commande de procédure du niveau de paramétrage).

Si la commande de procédure S-0-0422 est exécutée avec succès, les données d'exploitation ne contiennent aucun IDN.

C.4.3.22 IDN S-0-0425 Contrôle de diagramme d'états de sous-appareil

C.4.3.22.1 Attributs

Le Tableau C.33 présente les attributs potentiels pour cet IDN.

Tableau C.33 – Attributs de l'IDN S-0-0425

Attribut	Valeur
Nom	Contrôle de diagramme d'états de sous-appareil
Version	—
Longueur	2
Format d'affichage	Binaire
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Jamais
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.22.2 Description

Le Tableau C.34 présente la structure du contrôle de diagramme d'états de sous-appareil.

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Tableau C.34 – Structure du contrôle de diagramme d'états d'appareil

Numéro de bit	Valeur	Description
15-1	—	(réservé)
0	—	Etat de découplage
	0	Couplé (Le diagramme d'états de sous-appareil est couplé au diagramme d'états de communication)
	1	Découplé (Le diagramme d'états de sous-appareil doit être découplé du diagramme d'états de communication. Une transition du diagramme d'états de communication n'entraîne pas une transition du diagramme d'états de sous-appareil.)

C.4.3.23 IDN S-0-0531 IDN fictif

C.4.3.23.1 Attributs

Le Tableau C.35 présente les attributs potentiels pour cet IDN.

Tableau C.35 – Attributs de l'IDN S-0-0531

Attribut	Valeur
Nom	Somme de contrôle relative aux données d'exploitation de sauvegarde
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.23.2 Description

L'appareil calcule la somme de contrôle lorsque l'IDN est lu via la voie de service.

Les paramètres sauvegardés dans l'IDN S-0-0192 permettent de calculer la somme de contrôle.

C.4.3.24 IDN S-0-1300.x.1 Nom de composant

C.4.3.24.1 Attributs

Le Tableau C.36 présente les attributs potentiels pour cet IDN.

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Tableau C.36 – Attributs de l'IDN S-0-1300.x.1

Attribut	Valeur
Nom	Nom de composant
Version	—
Longueur	1, variable
Format d'affichage	Texte
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	—
Unité	—

C.4.3.24.2 Description

Le contenu de cet IDN est spécifique au constructeur et comporte le nom du ou des composants selon l'appareil, par exemple, moteur, amplificateur, alimentation, coupleur de bus. Le contenu peut être utilisé à des fins d'affichage uniquement.

C.4.3.25 IDN S-0-1300.x.2 Nom du fournisseur

C.4.3.25.1 Attributs

Le Tableau C.37 présente les attributs potentiels pour cet IDN.

Tableau C.37 – Attributs de l'IDN S-0-1300.x.2

Attribut	Valeur
Nom	Nom du fournisseur
Version	—
Longueur	1, variable
Format d'affichage	Texte
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	—
Unité	—

C.4.3.25.2 Description

Cet IDN contient le nom du fournisseur de l'appareil.

C.4.3.26 IDN S-0-1300.x3 Code fournisseur

C.4.3.26.1 Attributs

Le Tableau C.38 présente les attributs potentiels pour cet IDN.

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Tableau C.38 – Attributs de l'IDN S-0-1300.x.3

Attribut	Valeur
Nom	Code fournisseur
Version	—
Longueur	2
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	—
Unité	—

C.4.3.26.2 Description

Le code fournisseur (voir Tableau C.39) est un numéro unique attribué à chaque fournisseur qui permet d'identifier un appareil de Type 19 placé sur le réseau de même type. Le fournisseur doit demander le code fournisseur auprès de l’organisme chargé de la clientèle Sercos.

Tableau C.39 – Code fournisseur

Valeur	Description
0x0000	Fournisseurs non enregistrés
Autres valeurs	Fournisseurs enregistrés

C.4.3.27 IDN S-0-1300.x.4 Nom d'appareil

C.4.3.27.1 Attributs

Le Tableau C.40 présente les attributs potentiels pour cet IDN.

Tableau C.40 – Attributs de l'IDN S-0-1300.x.4

Attribut	Valeur
Nom	Nom d'appareil
Version	—
Longueur	1, variable
Format d'affichage	Texte
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	—
Unité	—

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C.4.3.27.2 Description

Le contenu de cet IDN est spécifique au constructeur et identifie le nom d'appareil publié sur la liste de prix du fournisseur.

C.4.3.28 IDN S-0-1300.x.5 ID d'appareil du fournisseur

C.4.3.28.1 Attributs

Le Tableau C.41 présente les attributs potentiels pour cet IDN.

Tableau C.41 – Attributs de l'IDN S-0-1300.x.5

Attribut	Valeur
Nom	ID d'appareil du fournisseur
Version	—
Longueur	1, variable
Format d'affichage	Texte
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	—
Unité	—

C.4.3.28.2 Description

L'ID d'appareil du fournisseur est un ID d'appareil unique géré par le fournisseur, et qui identifie le nombre de composants.

C.4.3.29 IDN S-0-1300.x.6 Connecté au sous-appareil

C.4.3.29.1 Attributs

Le Tableau C.42 présente les attributs potentiels pour cet IDN.

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Tableau C.42 – Attributs de l'IDN S-0-1300.x.6

Attribut	Valeur
Nom	Connecté au sous-appareil
Version	—
Longueur	2
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	—
Unité	—

C.4.3.29.2 Description

Lorsqu'un appareil comprend plusieurs sous-appareils et lorsque le composant est attribué à un sous-appareil spécifique, les données d'exploitation indiquent le nombre d'esclaves attribué.

C.4.3.30 IDN S-0-1300.x.7 Révision de fonctions

C.4.3.30.1 Attributs

Le Tableau C.43 présente les attributs potentiels pour cet IDN.

Tableau C.43 – Attributs de l'IDN S-0-1300.x.7

Attribut	Valeur
Nom	Révision de fonctions
Version	—
Longueur	2
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	0
Valeur d'entrée maximale	9999
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	—
Unité	—

C.4.3.30.2 Description

La révision de fonctions doit être ajustée dans le cas de corrections de fonctionnement de ce composant. Le constructeur de l'appareil garantit la compatibilité. La révision de fonctions ne doit pas être effectuée au démarrage du système.

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C.4.3.31 IDN S-0-1300.x.8 Révision du matériel

C.4.3.31.1 Attributs

Le Tableau C.44 présente les attributs potentiels pour cet IDN.

Tableau C.44 – Attributs de l'IDN S-0-1300.x.8

Attribut	Valeur
Nom	Révision du matériel
Version	—
Longueur	1, variable
Format d'affichage	Texte
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	—
Unité	—

C.4.3.31.2 Description

Ce paramètre contient la révision du matériel propre à l'appareil, et peut par conséquent être utilisé pour l'identification. La révision du matériel comprend la révision du logiciel (S-0-1300.x.09) si elle n'est pas prise en charge par l'appareil. La révision du matériel est spécifiée par le constructeur (par exemple, 103).

C.4.3.32 IDN S-0-1300.x.9 Révision du logiciel

C.4.3.32.1 Attributs

Le Tableau C.45 présente les attributs potentiels pour cet IDN.

Tableau C.45 – Attributs de l'IDN S-0-1300.x.9

Attribut	Valeur
Nom	Révision du logiciel
Version	—
Longueur	1, variable
Format d'affichage	Texte
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	—
Unité	—

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C.4.3.32.2 Description

Ce paramètre contient la version du logiciel ou micrologiciel propre à l'appareil, et peut par conséquent être utilisé pour l'identification. La révision du logiciel est spécifiée par le constructeur.

C.4.3.33 IDN S-0-1300.x.10 Révision du chargeur de micrologiciel

C.4.3.33.1 Attributs

Le Tableau C.46 présente les attributs potentiels pour cet IDN.

Tableau C.46 – Attributs de l'IDN S-0-1300.x.10

Attribut	Valeur
Nom	Révision du chargeur de micrologiciel
Version	—
Longueur	1, variable
Format d'affichage	Texte
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	—
Unité	—

C.4.3.33.2 Description

Ce paramètre contient la révision du chargeur de micrologiciel ou de démarrage mise en œuvre dans l'appareil. La révision du chargeur de micrologiciel est spécifiée par le constructeur.

C.4.3.34 IDN S-0-1300.x.11 Numéro de commande

C.4.3.34.1 Attributs

Le Tableau C.47 présente les attributs potentiels pour cet IDN.

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Tableau C.47 – Attributs de l'IDN S-0-1300.x.11

Attribut	Valeur
Nom	Numéro de commande
Version	—
Longueur	1, variable
Format d'affichage	Texte
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	—
Unité	—

C.4.3.34.2 Description

Ce paramètre contient le numéro de commande de l'appareil, et peut par conséquent être utilisé pour l'identification. Le client a besoin du numéro de commande pour commander un appareil donné. Le numéro de commande est spécifié par le constructeur.

C.4.3.35 IDN S-0-1300.x.12 Numéro de série

C.4.3.35.1 Attributs

Le Tableau C.48 présente les attributs potentiels pour cet IDN.

Tableau C.48 – Attributs de l'IDN S-0-1300.x.12

Attribut	Valeur
Nom	Numéro de série
Version	—
Longueur	1, variable
Format d'affichage	Texte
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	—
Unité	—

C.4.3.35.2 Description

Ce paramètre contient le numéro de série de l'appareil, et peut par conséquent être utilisé pour l'identification. Le numéro de série est défini et attribué par le constructeur, et identifie de manière unique chaque appareil (par exemple, 1234567890).

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C.4.3.36 IDN S-0-1300.x.13 Date de construction

C.4.3.36.1 Attributs

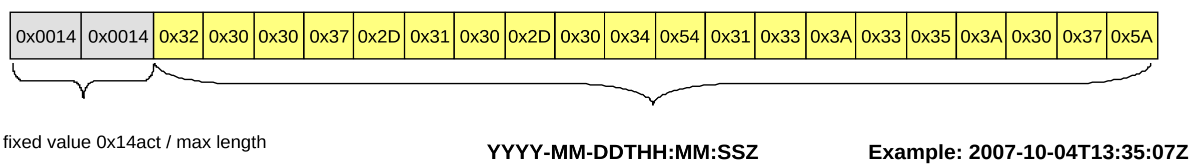
Le Tableau C.49 présente les attributs potentiels pour cet IDN.

Tableau C.49 – Attributs de l'IDN S-0-1300.x.13

Attribut	Valeur
Nom	Date de construction
Version	—
Longueur	1, variable
Format d'affichage	Texte
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	toujours
Facteur de conversion	1
Mise à l'échelle/résolution	—
Unité	—

C.4.3.36.2 Description

Cet IDN contient la date et l'heure de fabrication du composant (voir Figure C.4). Cette information est fournie par une chaîne de texte formatée comme cela est décrit dans l'ISO 8601 (format étendu):



Légende

Anglais	Français
Fixed value 0x14 act / max length	Valeur fixe 0x14 pour longueur actuelle / maximale
Example	Exemple

Figure C.4 – Structure de l'information concernant la date

L'information concernant la date est séparée par un tiret "-" et l'information concernant l'heure est séparée par un ":". La date et l'heure sont séparées par un caractère "T". La dernière lettre du texte qui en résulte est un Z (fuseau horaire UTC) avec une longueur fixe de 20 caractères.

C.4.3.37 IDN S-0-1300.x.14 Date AQ

C.4.3.37.1 Attributs

Le Tableau C.50 présente les attributs potentiels pour cet IDN.

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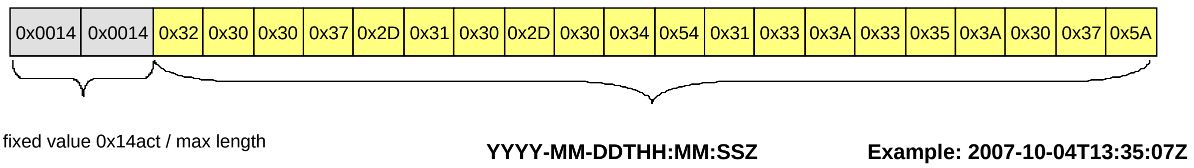
Tableau C.50 – Attributs de l'IDN S-0-1300.x.14

Attribut	Valeur
Nom	Date AQ
Version	—
Longueur	1, variable
Format d'affichage	Texte
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	—
Unité	—

C.4.3.37.2 Description

Cet IDN contient la date et l'heure de réalisation de l'essai d'assurance qualité pour le composant concerné (voir Figure C.5). L'assurance qualité constitue l'un des essais du produit final visant à s'assurer que le produit conserve le niveau de qualité souhaité.

Cette information est fournie par une chaîne de texte formatée comme cela est décrit dans l'ISO 8601:2006-09 / EN 28601 (format étendu):



Légende

Anglais	Français
Fixed value 0x14 act / max length	Valeur fixe 0x14 pour longueur actuelle / maximale
Example	exemple

Figure C.5 – Structure de l'information concernant la date AQ

L'information concernant la date est séparée par un tiret "-" et l'information concernant l'heure est séparée par un ":". La date et l'heure sont séparées par un caractère "T". La dernière lettre du texte qui en résulte est un Z (fuseau horaire UTC) avec une longueur fixe de 20 caractères.

C.4.3.38 IDN S-0-1300.x.20 Heures de fonctionnement

C.4.3.38.1 Attributs

Le Tableau C.51 présente les attributs potentiels pour cet IDN.

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Tableau C.51 – Attributs de l'IDN S-0-1300.x.20

Attribut	Valeur
Nom	Heures de fonctionnement
Version	—
Longueur	4
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1 h
Unité	h

C.4.3.38.2 Description

Ce paramètre contient les heures de fonctionnement du composant. L'appareil doit archiver ces données dans une mémoire de sauvegarde.

C.4.3.39 IDN S-0-1300.x.21 Date de service

C.4.3.39.1 Attributs

Le Tableau C.52 présente les attributs potentiels pour cet IDN.

Tableau C.52 – Attributs de l'IDN S-0-1300.x.21

Attribut	Valeur
Nom	Date de service
Version	—
Longueur	1, variable
Format d'affichage	Texte
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.39.2 Description

Cet IDN contient la date et l'heure du dernier entretien (maintenance) de l'appareil, par exemple, mise à jour du micrologiciel (voir Figure C.6).

Cette information est fournie par une chaîne de texte formatée comme cela est décrit dans l'ISO 8601 (format étendu):

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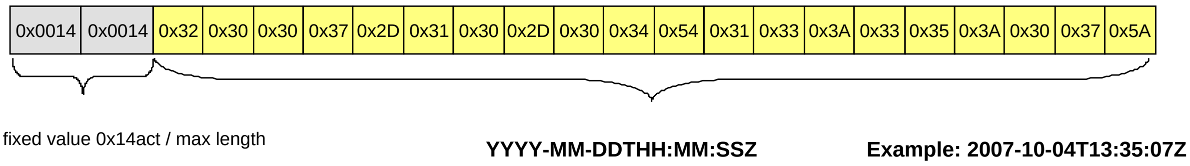

Légende

Anglais	Français
Fixed value 0x14 act / max length	Valeur fixe 0x14 pour longueur actuelle / maximale
Example	Exemple

Figure C.6 – Structure de l'information concernant la date de service

L'information concernant la date est séparée par un tiret "-" et l'information concernant l'heure est séparée par un ":". La date et l'heure sont séparées par un caractère "T". La dernière lettre du texte qui en résulte est un Z (fuseau horaire UTC) avec une longueur fixe de 20 caractères.

C.4.3.40 IDN S-0-1300.x.22 Date d'étalonnage

C.4.3.40.1 Attributs

Le Tableau C.53 présente les attributs potentiels pour cet IDN.

Tableau C.53 – Attributs de l'IDN S-0-1300.x.22

Attribut	Valeur
Nom	Date d'étalonnage
Version	—
Longueur	1, variable
Format d'affichage	Texte
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Jamais
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.40.2 Description

Cet IDN contient la date et l'heure du dernier étalonnage de l'appareil (voir Figure C.7). Un ingénieur de maintenance doit inscrire la date et l'heure actuelles dans cet IDN après un étalonnage. Parallèlement, la date et l'heure du prochain étalonnage requis doivent être inscrites dans l'IDN S-0-1300.x.23.

Cette information est fournie par une chaîne de texte formatée comme cela est décrit dans l'ISO 8601 (format étendu):

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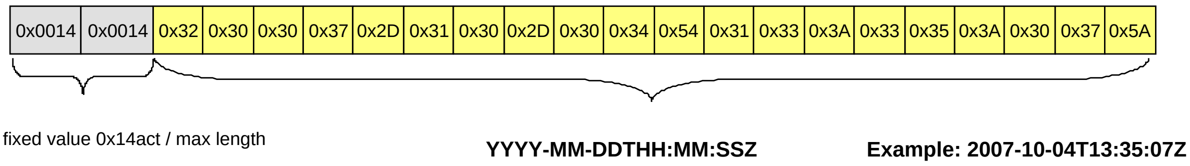

Légende

Anglais	Français
Fixed value 0x14 act / max length	Valeur fixe 0x14 pour longueur actuelle / maximale
Example	exemple

Figure C.7 – Structure de l'information concernant la date d'étalonnage

L'information concernant la date est séparée par un tiret "-" et l'information concernant l'heure est séparée par un ":". La date et l'heure sont séparées par un caractère "T". La dernière lettre du texte qui en résulte est un Z (fuseau horaire UTC) avec une longueur fixe de 20 caractères.

C.4.3.41 IDN S-0-1300.x.23 Date limite d'étalonnage

C.4.3.41.1 Attributs

Le Tableau C.54 présente les attributs potentiels pour cet IDN.

Tableau C.54 – Attributs de l'IDN S-0-1300.x.23

Attribut	Valeur
Nom	Date limite d'étalonnage
Version	—
Longueur	1, variable
Format d'affichage	Texte
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Jamais
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.41.2 Description

Cet IDN contient la date et l'heure du prochain étalonnage de l'appareil (voir Figure C.8). Après qu'un ingénieur de maintenance a effectué un étalonnage, la date et l'heure actuelles doivent être inscrites dans S-0-1300.x.22 et la date et d'heure du prochain étalonnage doivent être inscrites dans cet IDN.

Cette information est fournie par une chaîne de texte formatée comme cela est décrit dans l'ISO 8601 (format étendu):

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0x0014	0x0014	0x32	0x30	0x30	0x37	0x2D	0x31	0x30	0x2D	0x30	0x34	0x54	0x31	0x33	0x3A	0x33	0x35	0x3A	0x30	0x37	0x5A

fixed value 0x14act / max length

YYYY-MM-DDTHH:MM:SSZ

Example: 2007-10-04T13:35:07Z

Légende

Anglais	Français
Fixed value 0x14 act / max length	Valeur fixe 0x14 pour longueur actuelle / maximale
Example	exemple

Figure C.8 – Structure de l'information concernant la date limite d'étalonnage

L'information concernant la date est séparée par un tiret "-" et l'information concernant l'heure est séparée par un ":". La date et l'heure sont séparées par un caractère "T". La dernière lettre du texte qui en résulte est un Z (fuseau horaire UTC) avec une longueur fixe de 20 caractères.

C.4.3.42 IDN S-0-1301 Liste des classes & Version GDP

C.4.3.42.1 Attributs

Le Tableau C.55 présente les attributs potentiels pour cet IDN.

Tableau C.55 – Attributs de l'IDN S-0-1301

Attribut	Valeur
Nom	Liste des classes & Version GDP
Version	—
Longueur	2, variable
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.42.2 Description

Ce paramètre contient une liste des capacités de profil générique et des versions dédiées du sous-appareil (voir Tableau C.56).

- Les bits 15 ... 8 indiquent la classe GDP,
- les bits 7 ... 4 sont réservés,
- les bits 3 ... 0 indiquent la version de cette classe GDP.

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Tableau C.56 – Structure des classes & version GDP

Code de classe Bits 15-8	Bits réservés 7-4	Bits de version 3-0	Nom de la classe	Description
0x00	0x0	0x1	—	Non utilisé
0x01	0x0	0x1	GDP_Basic	Le profil générique doit être pris en charge par chaque sous-appareil
0x02	0x0	0x1	GDP_Id	Identification
0x03	0x0	0x1	GDP_QS	Système qualité
0x04	0x0	0x1	GDP_Rev	Révision
0x05	0x0	0x1	GDP_LNg	Langue
0x06	0x0	0x1	GDP_StM	Diagramme d'états
0x07	0x0	0x1	GDP_CKs	Somme de contrôle
0x08	0x0	0x1	GDP_CKsUser	Utilisateur de la somme de contrôle
0x09	0x0	0x1	GDP_BKP	Sauvegarde
0x0A	0x0	0x1	GDP_BKPAdv	Sauvegarde avancée
0x0B	0x0	0x1	GDP_DiagT	Trace de diagnostic
0x0C	0x0	0x1	GDP_DiagTAdv	Trace de diagnostic avancée
0x0D	0x0	0x1	GDP_PWD	Mot de passe
0x0E-0xF	0x0	0x1	(réservé)	Pour des extensions futures
0x10	0x0	0x1	GDP_RST	Redémarrage
0x11	0x0	0x1	GDP_CIPSafetyDev	Appareil de sécurité CIP
0x12-0xFF	0xn	0xn	(réservé)	Pour des extensions futures

C.4.3.43 IDN S-0-1302.x.1 Type & Version FSP

C.4.3.43.1 Attributs

Le Tableau C.57 présente les attributs potentiels pour cet IDN.

Tableau C.57 – Attributs de l'IDN S-0-1302.x.1

Attribut	Valeur
Nom	Type & Version FSP
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

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C.4.3.43.2 Description

Le FSP Type & Version indique le type spécifique à la fonction et la version des ressources dépendant de la fonction comme cela est présenté dans le Tableau C.58.

Tableau C.58 – Codage de S-1302.x.01

Numéro de bit	Valeur	Description
31	—	P/S
	0	Défini par le Type 19
	1	Défini par le constructeur
30-16	—	Types FSP de Type 19
	0x00	(réservé)
	0x01	FSP ES
	0x02	FSP Système d'entraînement
	0x03	FSP codeur
	0x04-0x7FFF	(réservé)
15-0	—	Version
	0x0000	(réservé)
	0x0001	Première version

C.4.3.44 IDN S-0-1302.x.2 Groupes de fonctions

C.4.3.44.1 Attributs

Le Tableau C.59 présente les attributs potentiels pour cet IDN.

Tableau C.59 – Attributs de l'IDN S-0-1302.x.2

Attribut	Valeur
Nom	Groupes de fonctions
Version	—
Longueur	4, variable (liste triée par SI)
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.44.2 Description

Les données d'exploitation de cet IDN contiennent une liste de tous les groupes de fonctions instanciés.

Cet IDN est présent uniquement dans le cas d'un appareil à structure modulaire selon, par exemple, FSP_IO. Dans le cas d'un FSP IO de ressource, cet IDN est une liste de groupes de fonctions ES de FSP_IO. Les éléments de cette liste contiennent les IDN. L'instance de

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structure présente le nombre d'ensembles du module (instance de structure = position du module), et l'élément de structure (SE) est toujours = 0. Lorsque le composant de poids fort est le coupleur de bus, cette liste commence par le coupleur de bus FG (S-0-1500 .0.0). Dans le cas contraire, la liste commence par le module ES de poids fort au numéro d'ensemble 1, par exemple, S-0-15xx.1.0. Si un module contient deux groupes de fonctions ES ou plus, il est nécessaire que chaque groupe de fonctions ES soit désigné.

Le mapping des données dans le conteneur InputData (S-0-1500.x.09) et dans le conteneur OutputData (S-0-1500.x.05) s'effectue en séquence des entrées de la liste (voir Figure C.9).

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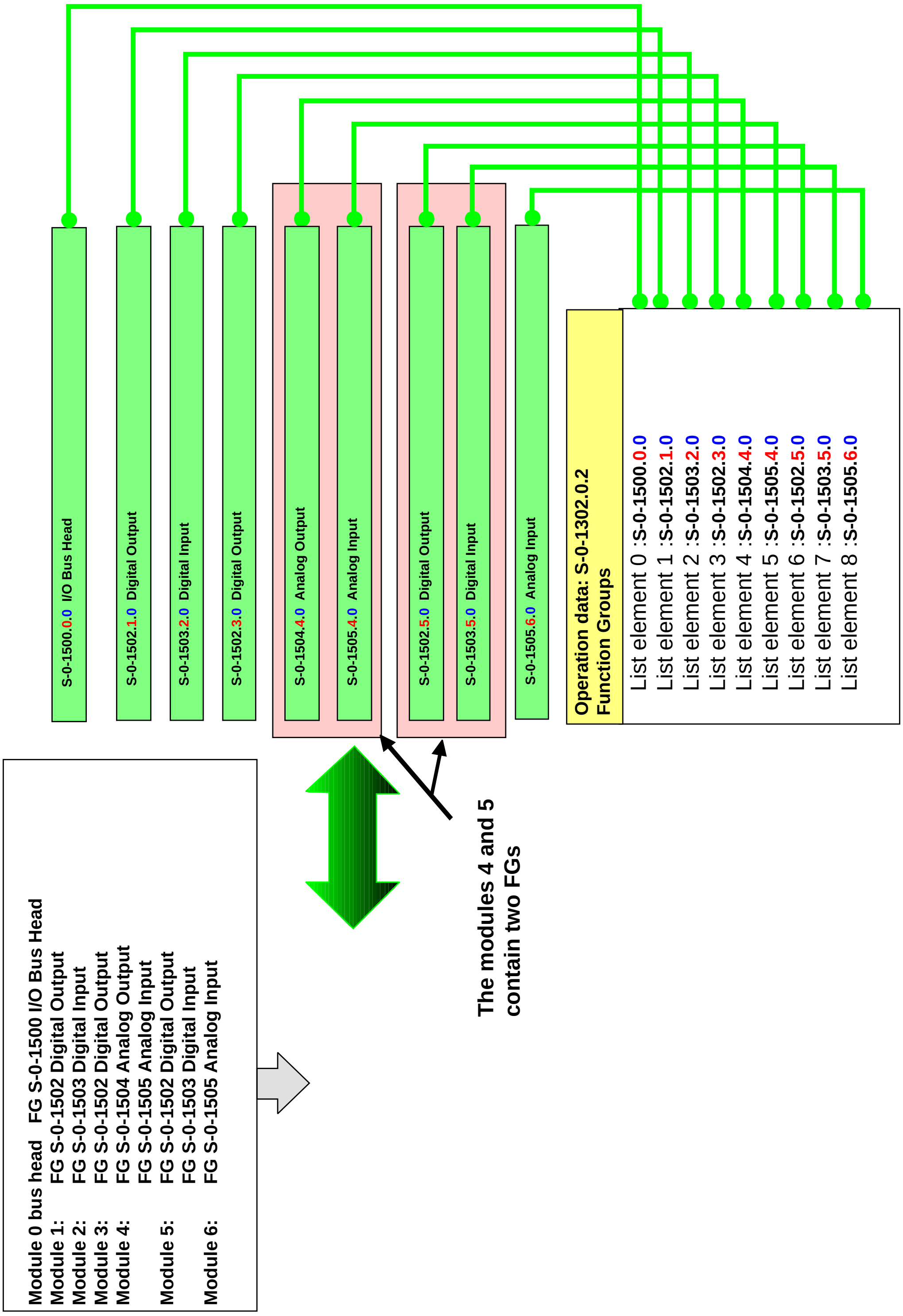

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Légende

Anglais	Français
Module 0 bus head	Module 0 – tête de bus
I/O bus head	Tête de bus E/S
Digital output	Sortie numérique
Digital input	Entrée numérique
Analog output	Sortie analogique
Analog input	Entrée analogique
The modules 4 and 5 contain two FGs	Les modules 4 et 5 contiennent deux FG
Operation data	Données de fonctionnement
Function groups	Groupes de fonctions
List element	Elément de liste

Figure C.9 – Mapping des données dans le conteneur InputData et dans le conteneur OutputData

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C.4.3.45 IDN S-0-1302.x.3 Type d'application

C.4.3.45.1 Attributs

Le Tableau C.60 présente les attributs potentiels pour cet IDN.

Tableau C.60 – Attributs de l'IDN S-0-1302.x.3

Attribut	Valeur
Nom	Type d'application
Version	—
Longueur	1, variable
Format d'affichage	Texte
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Jamais
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.45.2 Description

Les données d'exploitation du type d'application contiennent le type de l'application du sous-appareil (par exemple, entraînement par broche couplée, axe rond, axe transversal, etc.). L'utilisateur peut programmer ce paramètre s'il le souhaite.

C.4.3.46 IDN S-0-1303.0.1 Configuration de trace de diagnostic

C.4.3.46.1 Attributs

Le Tableau C.61 présente les attributs potentiels pour cet IDN.

Tableau C.61 – Attributs de l'IDN S-0-1303.0.1

Attribut	Valeur
Nom	Configuration de trace de diagnostic
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

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C.4.3.46.2 Description

L'IDN S-0-1303.0.01 décrit l'extension configurée de la trace de diagnostic énumérée dans les IDN S-0-1303.0.12 à S-0-1303.0.127. Cet IDN présente une liste des IDN supplémentaires ajoutés à la trace de diagnostic dans la même séquence (par exemple, S-0-1500.x.33 Message de diagnostic ES actuel dans le cas de FSP ES).

Le contenu de l'IDN S-0-1303.0.01 est défini par le constructeur.

C.4.3.47 IDN S-0-1303.0.2 Déclaration de trace de diagnostic

C.4.3.47.1 Attributs

Le Tableau C.62 présente les attributs potentiels pour cet IDN.

Tableau C.62 – Attributs de l'IDN S-0-1303.0.2

Attribut	Valeur
Nom	Déclaration de trace de diagnostic
Version	—
Longueur	2
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Non défini
Facteur de conversion	1
Mise à l'échelle/résolution	—
Unité	—

C.4.3.47.2 Description

Ce paramètre régule le flux de trace de diagnostic tel que présenté dans le Tableau C.63.

Tableau C.63 – Codage de S-1303.0.02

Numéro de bit	Valeur	Description
15	—	organisation (le maître commande l'organisation de la mémoire tampon de diagnostic)
	0	Anneau
	1	Liste
14-8	—	(réservé)
7-4	—	Le seuil de la classe de diagnostic correspond aux bits 19..16 S-0-0390. Seul le diagnostic avec des classes supérieures ou égales est saisi
3-2	—	((réservé))
1		Réinitialisation de la mémoire tampon (La mémoire tampon est supprimée conjointement aux informations concernant l'état. Si l'indicateur de niveau est pris en charge, il est réglé sur 1.)
0	—	Enregistrement
	0	Saisie (La trace de diagnostic saisit les diagnostics.)
	1	Blocage (La trace de diagnostic ne saisit aucun diagnostic. Une évaluation cohérente des mémoires tampon de diagnostic est de ce fait possible).

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C.4.3.48 IDN S-0-1303.0.3 Etat de trace de diagnostic

C.4.3.48.1 Attributs

Le Tableau C.64 présente les attributs potentiels pour cet IDN.

Tableau C.64 – Attributs de l'IDN S-0-1303.0.3

Attribut	Valeur
Nom	Etat de trace de diagnostic
Version	—
Longueur	2
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.48.2 Description

Ce paramètre montre l'état du flux de trace de diagnostic tel que présenté dans le Tableau C.65.

Tableau C.65 – Codage de S-1303.0.2

Numéro de bit	Valeur	Description
15	—	organisation (présente l'organisation de la mémoire tampon)
	0	anneau (le flux de trace est organisé comme un anneau)
	1	liste (le flux de trace est organisé comme une liste)
14-4	—	(réservé)
3	—	Dépassement, indique le dépassement de la mémoire tampon de trace de diagnostic, c'est-à-dire - dans le cas d'une liste, pertes des nouvelles entrées, - dans le cas d'un anneau, les anciennes entrées sont remplacées.
	0	absence de dépassement
	1	Dépassement effectif
2-1	—	Indicateur de niveau
	3	Plein (Indique que la mémoire tampon de trace de diagnostic est pleine, mais n'est pas encore dépassée.)
	2	Remplie ((Indique que la mémoire tampon de trace de diagnostic contient au moins une entrée.)
	1	Vide ((Indique que la mémoire tampon de trace de diagnostic ne contient aucune entrée.)
	0	— niveau d'indication inexistant
0	—	Enregistrement
	0	Saisie
	1	Blocage

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C.4.3.49 IDN S-0-1303.0.10 Mémoire tampon de trace de diagnostic n°1

C.4.3.49.1 Attributs

Le Tableau C.66 présente les attributs potentiels pour cet IDN.

Tableau C.66 – Attributs de l'IDN S-0-1303.0.10

Attribut	Valeur
Nom	Mémoire tampon de trace de diagnostic n°1
Version	—
Longueur	4, variable
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	unité du paramètre

C.4.3.49.2 Description

Ce paramètre contient une ligne de traces de diagnostic. Les informations sont organisées sous forme de mémoire tampon ou de liste d'anneau.

Dans la mémoire tampon, chaque diagnostic qui se produit dans le sous-appareil est enregistré sous la forme de S-0-0390 (Numéro de diagnostic).

Il n'est pas nécessaire de signifier un événement, enregistré dans la trace de diagnostic, via l'IDN S-0-0390 (Numéro de diagnostic) en raison des priorités de diagnostic.

C.4.3.50 IDN S-0-1303.0.11 Mémoire tampon de trace de diagnostic n°2

C.4.3.50.1 Attributs

Le Tableau C.67 présente les attributs potentiels pour cet IDN.

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Tableau C.67 – Attributs de l'IDN S-0-1303.0.11

Attribut	Valeur
Nom	Mémoire tampon de trace de diagnostic n°2
Version	—
Longueur	8, variable
Format d'affichage	date et heure
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	Unité du paramètre

C.4.3.50.2 Description

Ce paramètre contient une ligne de traces de diagnostic et des informations organisées sous forme de mémoire tampon ou de liste d'anneau. La configuration est fixée sur l'heure actuelle de Type 19 (S-0-1305.0.01) du numéro de diagnostic associé.

C.4.3.51 IDN S-0-1303.0.12 Mémoire tampon de trace de diagnostic n°3

C.4.3.51.1 Attributs

Le Tableau C.68 présente les attributs potentiels pour cet IDN.

Tableau C.68 – Attributs de l'IDN S-0-1300.0.12

Attribut	Valeur
Nom	Mémoire tampon de trace de diagnostic n°3
Version	—
Longueur	Longueur de paramètre, variable
Format d'affichage	Format du paramètre
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	Unité du paramètre

C.4.3.51.2 Description

Ce paramètre contient une ligne de traces de diagnostic et des informations organisées sous forme de mémoire tampon ou de liste d'anneau. La configuration est fixée sur l'heure actuelle de Type 19 (S-0-1305.0.01) du numéro de diagnostic associé. Cet IDN présente la ligne suivante de traces de diagnostic.

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C.4.3.52 IDN S-0-1305.0.1 Heure actuelle de Type 19

C.4.3.52.1 Attributs

Le Tableau C.69 présente les attributs potentiels pour cet IDN.

Tableau C.69 – Attributs de l'IDN S-0-1305.0.1

Attribut	Valeur
Nom	Heure actuelle de Type 19
Version	—
Longueur	8
Format d'affichage	Heure de Type 19
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Jamais
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.52.2 Description

Ce paramètre contient l'heure de Type 19 actuelle au format de la CEI 61588 (voir Tableau C.70). Le sous-appareil doit marquer les événements avec cette heure (par exemple, S-0-1305.0.01 Heure actuelle de Type 19 marque la trace de diagnostic (S-0-1303) avec des datations).

Ce paramètre doit devenir actif lors du démarrage de l'appareil, la valeur initiale de 0 indiquant que l'heure actuelle de Type 19 n'a pas réglée.

La CEI a établi que la valeur = 0x0 correspond à 1970-01-01, 00:00, 0 s, 0 ns.

Si SCP_SysTime est activé dans l'esclave, ce paramètre doit alors être protégé en écriture dans les phases CP3 et CP4.

Tableau C.70 – Structure de l'heure de Type 19

Numéro de bit	Valeur	Description
63-32		Secondes
31-0		Nanosecondes

C.4.3.53 IDN S-0-1305.0.2 Heure précise actuelle de Type 19

C.4.3.53.1 Attributs

Le Tableau C.71 présente les attributs potentiels pour cet IDN.

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Tableau C.71 – Attributs de l'IDN S-0-1305.0.2

Attribut	Valeur
Nom	Heure précise actuelle de Type 19
Version	—
Longueur	4
Format d'affichage	Décimale non signée
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Jamais
Facteur de conversion	1
Mise à l'échelle/résolution	0,001 µs
Unité	µs

C.4.3.53.2 Description

Ce paramètre contient les 32 bits de poids faible de l'heure de Type 19 actuelle au format de la CEI 61588. Le sous-appareil peut utiliser ce paramètre pour marquer les événements avec cette heure.

Si SCP_SysTime est activé dans l'esclave, ce paramètre doit alors être protégé en écriture dans les phases CP3 et CP4.

C.4.3.54 IDN S-0-1310 Liste des IDN de données d'exploitation différentes des données par défaut

C.4.3.54.1 Attributs

Le Tableau C.72 présente les attributs potentiels pour cet IDN.

Tableau C.72 – Attributs de l'IDN S-0-1310

Attribut	Valeur
Nom	Liste des IDN de données d'exploitation différentes des données par défaut
Version	—
Longueur	4, variable
Format d'affichage	IDN
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Toujours
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.54.2 Description

Cette liste des IDN est gérée par l'appareil et contient par ailleurs une liste de tous les IDN dont les données d'exploitation sont différentes des données par défaut.

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C.4.3.55 IDN S-0-1350 Appareil de redémarrage

C.4.3.55.1 Attributs

Le Tableau C.73 présente les attributs potentiels pour cet IDN.

Tableau C.73 – Attributs de l'IDN S-0-1350

Attribut	Valeur
Nom	Appareil de redémarrage
Version	—
Longueur	2
Format d'affichage	Binaire
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	OL
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.55.2 Description

Le maître utilise cette commande de procédure pour initialiser un redémarrage de l'appareil tout entier.

- Si S-0-1350.0.1 Retard de l'appareil de redémarrage existe, l'appareil est mis en attente pour l'intervalle de temps qui est défini dans S-0-1350.0.1, avant l'exécution du redémarrage.
- Si S-0-1350.0.1 Retard de l'appareil de redémarrage n'existe pas, l'appareil est mis en attente pendant 2 secondes au minimum et 30 secondes au maximum avant l'exécution du redémarrage. Ceci donne la possibilité au maître de redémarrer plusieurs appareils dans l'anneau.

NOTE Le redémarrage d'un appareil conduit à l'interruption de la communication de Type 19; il est donc nécessaire de reprendre l'exécution de la phase de communication.

C.4.3.56 IDN S-0-1399.0.1 Evènement de diagnostic des IDN d'essai

C.4.3.56.1 Attributs

Le Tableau C.74 présente les attributs potentiels pour cet IDN.

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Tableau C.74 – Attributs de l'IDN S-0-1310

Attribut	Valeur
Nom	Evènement de diagnostic des IDN d'essai
Version	—
Longueur	4
Format d'affichage	Hexadécimal
Valeur d'entrée minimale	—
Valeur d'entrée maximale	—
Positions après la décimale	0
Protection en écriture	Jamais
Facteur de conversion	1
Mise à l'échelle/résolution	1
Unité	—

C.4.3.56.2 Description

L'écriture de cet IDN entraîne un diagnostic spécifique à l'application dans le sous-appareil. Le diagnostic d'origine virtuelle doit être traité dans le sous-appareil comme un diagnostic réel. Cela signifie que le diagnostic d'origine virtuelle a une influence sur tous les mécanismes de diagnostic de Type 19 pris en charge, qui sont entre autres (liste non exhaustive):

Profil de communication (SCP)

- S-0-0014 (Etat d'interface)
- S-0-1028 (Compteur d'erreurs MST-P/S)
- S-0-1035 (Compteur d'erreurs Port 1 et Port 2)
- S-0-1045 (Etat d'appareil (S-DEV))
- S-0-1050.x.08 (Commande de connexion)
- S-0-1050.x.12 (Pertes de données des compteurs d'erreurs)

Profil d'appareil générique (GDP)

- S-0-0095 (Message de diagnostic)
- S-0-0390 (Numéro de diagnostic)
- S-0-1303 (Trace de diagnostic)
- DEL de Type 19

Profil spécifique à la fonction Système d’entraînement (FSP Système d’entraînement)

- S-0-0011 (Diagnostic de classe 1(C1D))
- S-0-0012 (Diagnostic de classe 2 (C2D))
- S-0-0135 (Etat d’entraînement)

Profil spécifique à la fonction ES (FSP ES)

- S-0-1500.x.02 (État ES)
- S-0-1500.x.32 (Message de diagnostic ES)
- IO_FG.x.17 (DIAGIN) (spécifique au fabricant)

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La structure des données d'exploitation de cet IDN est quasi identique aux données d'exploitation du Numéro de diagnostic (S-0-0390) (sauf les bits 30-31). L'écriture de cet IDN avec l'ensemble de 31 bits doit entraîner un diagnostic avec les types de source, classe et code source spécifiés dans les données d'exploitation.

Par ailleurs, les diagnostics provoqués par cet IDN doivent pouvoir être redéfinis par l'écriture de cet IDN contenant le diagnostic qu'il convient de réinitialiser, ainsi que le bit 31 réglé sur 0.

Tableau C.75 – Structure de diagnostic des IDN d'essai

Numéro de bit	Valeur	Description
31	—	Niveau d'activation (Le bit 31 indique si le diagnostic est activé ou désactivé.)
	0	Désactivation du diagnostic (L'écriture de cet IDN avec ce bit réglé sur 0, désactive le diagnostic correspondant dans l'esclave)
	1	Activation du diagnostic (L'écriture de cet IDN avec ce bit réglé sur 0, active le diagnostic correspondant dans l'esclave)
30	—	Interprétation du code d'état (Le bit 30 définit l'interprétation du code d'état)
	0	codes d'état spécifiques au constructeur (codes d'état des bits 15-0 définis par le constructeur)
	1	Standard (les codes d'état sont définis par le Type 19)
29-24		Type de source (Le codage est identique à S-0-0390 (Numéro de diagnostic) bits 24-29)
23-20		(réservé)
19-16		Classe (Le codage est identique à S-0-0390 (Numéro de diagnostic) bits 16-19)
15-0		Code d'état

C.5 Codes d'état GDP

L'article suivant définit les codes d'état dédiés au GDP, utilisés pour la présentation neutre des informations de diagnostic des appareils esclaves de Type 19.

Les codes d'état, énumérés dans le Tableau C.76 et le Tableau C.77, sont regroupés en différentes catégories selon leur classe de diagnostic attribuée fixe.

Tableau C.76 – Codes d'état avec la classe de diagnostic "état de fonctionnement"

Code (hex)	Description
A010	L'appareil a redémarré (mise sous tension)
A100	Saisie du mauvais mot de passe
A110	Protection en écriture du mot de passe désactivée
A120	Mot de passe modifié
A200	Trace de diagnostic initiée
A210	Trace de diagnostic interrompue
A220	Dépassement de la mémoire tampon de trace de diagnostic
A300	Ecriture du ou des IDN d'essai

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Tableau C.77 – Codes d'état avec la classe de diagnostic "état spécifique de la commande de procédure"

Code (hex)	Description
200	S-0-0422 Quitter la commande de procédure de niveau de paramétrage
201	Ensemble de paramètres incorrect ou incomplet (voir S-0-0423 liste des IDN de données invalides pour le niveau de paramétrage)
202	Violation des limites de paramètres (voir S-0-0423 Liste des IDN de données invalides pour le niveau de paramétrage)
203	Erreur de conversion des paramètres (voir S-0-0423 Liste des IDN de données invalides pour le niveau de paramétrage)
400	S-0-0420 Activer la commande de procédure de niveau de paramétrage (PL)
401	La commutation sur le niveau de paramétrage n'est pas possible
500	S-0-0099 Diagnostic de classe 1 de réinitialisation
700	S-0-0262 Commande de procédure de défauts de charge
2200	S-0-0264 Commande de procédure de mémoire de travail de sauvegarde
2300	S-0-0263 Commande de procédure de mémoire de travail de charge
2400	S-0-0293 Commande de procédure de mémoire de travail de sauvegarde sélectionnée

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[1] Ces sous-parties sont actuellement les normes CEI 61800-7-201, CEI 61800-7-202, CEI 61800-7-203 et CEI 61800-7-204.

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