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Industrial communication networks – Fieldbus specifications – Part 3-16: Data-link layer service definition – Type 16 elements

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INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 3-16: Data-link layer service definition – Type 16 elements

FOREWORD

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NOTE Use of some of the associated protocol types is restricted by their intellectual-property-right holders. In all cases, the commitment to limited release of intellectual-property-rights made by the holders 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 IEC 61784 series. Use of the various protocol types in other combinations may require permission of their respective intellectual-property-right holders.

International Standard IEC 61158-3-16 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This first edition and its companion parts of the IEC 61158-3 subseries cancel and replace IEC 61158-3:2003. This edition of this part constitutes a technical addition. This publication, together with its companion parts for Type 16, also partially replaces IEC 61491:2002 which is at present being revised. IEC 61491 will be issued as a technical report.

This edition includes the following significant changes with respect to the previous edition:

a) deletion of the former Type 6 fieldbus, and the placeholder for a Type 5 fieldbus data-link layer, for lack of market relevance;
b) addition of new types of fieldbuses;
c) division of this part into multiple parts numbered 3-1, 3-2, …, 3-19.

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

FDIS	Report on voting
65C/473/FDIS	65C/484/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 ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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:

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

NOTE The revision of this standard will be synchronized with the other parts of the IEC 61158 series.

The 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.

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/TR 61158-1.

Throughout the set of fieldbus standards, the term "service" refers to the abstract capability provided by one layer of the OSI Basic Reference Model to the layer immediately above. Thus, the data-link layer service defined in this standard is a conceptual architectural service, independent of administrative and implementation divisions.

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 3-16: Data-link layer service definition – Type 16 elements

1 Scope

1.1 Overview

This standard provides common elements for basic time-critical messaging communications between devices in an automation environment. The term “time-critical” is used to represent the presence of a time-window, within which one or more specified actions are required to be completed with some defined level of certainty. Failure to complete specified actions within the time window risks failure of the applications requesting the actions, with attendant risk to equipment, plant and possibly human life.

This standard defines in an abstract way the externally visible service provided by the Type 16 fieldbus data-link layer in terms of

a) the primitive actions and events of the service;

b) the parameters associated with each primitive action and event, and the form which they take; and

c) the interrelationship between these actions and events, and their valid sequences.

The purpose of this standard is to define the services provided to

- the Type 16 fieldbus application layer at the boundary between the application and data-link layers of the fieldbus reference model, and
- systems management at the boundary between the data-link layer and systems management of the fieldbus reference model.

1.2 Specifications

The principal objective of this standard is to specify the characteristics of conceptual data-link layer services suitable for time-critical communications, and thus supplement the OSI Basic Reference Model in guiding the development of data-link protocols for time-critical communications. A secondary objective is to provide migration paths from previously-existing industrial communications protocols.

This specification may be used as the basis for formal DL-Programming-Interfaces. Nevertheless, it is not a formal programming interface, and any such interface will need to address implementation issues not covered by this specification, including

a) the sizes and octet ordering of various multi-octet service parameters, and

b) the correlation of paired request and confirm, or indication and response, primitives.

1.3 Conformance

This standard does not specify individual implementations or products, nor do they constrain the implementations of data-link entities within industrial automation systems.

There is no conformance of equipment to this data-link layer service definition standard. Instead, conformance is achieved through implementation of the corresponding data-link protocol that fulfills the Type 16 data-link layer services defined in this standard.

2 Normative references

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

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

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

ISO/IEC 10731, *Information technology – Open Systems Interconnection – Basic Reference Model – Conventions for the definition of OSI services*

3 Terms, definitions, symbols, 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:

3.1.1 DL-address [7498-3]

3.1.2 DL-address-mapping [7498-1]

3.1.3 called-DL-address [7498-3]

3.1.4 calling-DL-address [7498-3]

3.1.5 centralized multi-end-point-connection [7498-1]

3.1.6 DL-connection [7498-1]

3.1.7 DL-connection-end-point [7498-1]

3.1.8 DL-connection-end-point-identifier [7498-1]

3.1.9 DL-connection-mode transmission [7498-1]

3.1.10 DL-connectionless-mode transmission [7498-1]

3.1.11 correspondent (N)-entities [7498-1]
correspondent DL-entities (N=2)
correspondent Ph-entities (N=1)

3.1.12 DL-duplex-transmission [7498-1]

3.1.13 (N)-entity [7498-1]
DL-entity (N=2)
Ph-entity (N=1)

3.1.14 DL-facility [7498-1]

3.1.15 flow control [7498-1]

3.1.16 (N)-layer [7498-1]
DL-layer (N=2)
Ph-layer (N=1)

3.1.17 layer-management [7498-1]

3.1.18 DL-local-view [7498-3]

3.1.19 DL-name [7498-3]

3.1.20 naming-(addressing)-domain [7498-3]

3.1.21 peer-entities [7498-1]

3.1.22 primitive name [7498-3]

3.1.23 DL-protocol [7498-1]

3.1.24 DL-protocol-connection-identifier [7498-1]

3.1.25 DL-protocol-data-unit [7498-1]

3.1.26 DL-relay [7498-1]

3.1.27 reset [7498-1]

3.1.28 responding-DL-address [7498-3]

3.1.29 routing [7498-1]

3.1.30 segmenting [7498-1]

3.1.31 (N)-service [7498-1]
DL-service (N=2)
Ph-service (N=1)

3.1.32 (N)-service-access-point [7498-1]
DL-service-access-point (N=2)
Ph-service-access-point (N=1)

3.1.33 DL-service-access-point-address [7498-3]

3.1.34 DL-service-connection-identifier [7498-1]

3.1.35 DL-service-data-unit [7498-1]

3.1.36 DL-simplex-transmission [7498-1]

3.1.37 DL-subsystem [7498-1]

3.1.38 systems-management [7498-1]

3.1.39 DL-user-data [7498-1]

3.2 Service convention terms and definitions

This standard also makes use of the following terms defined in ISO/IEC 10731 as they apply to the data-link layer:

3.2.1 acceptor

3.2.2 asymmetrical service

3.2.3 confirm (primitive);
requestor.deliver (primitive)

3.2.4 deliver (primitive)

3.2.5 DL-confirmed-facility

3.2.6 DL-facility

3.2.7 DL-local-view

3.2.8 DL-mandatory-facility

3.2.9 DL-non-confirmed-facility

3.2.10 DL-provider-initiated-facility

3.2.11 DL-provider-optional-facility

3.2.12 DL-service-primitive;
primitive

3.2.13 DL-service-provider

3.2.14 DL-service-user

3.2.15 DL-user-optional-facility

3.2.16 indication (primitive);
acceptor.deliver (primitive)

3.2.17 multi-peer

3.2.18 request (primitive);
requestor.submit (primitive)

3.2.19 requestor

3.2.20 response (primitive);
acceptor.submit (primitive)

3.2.21 submit (primitive)

3.2.22 symmetrical service

3.3 Data-link service terms and definitions

3.3.1
cycle time
duration of a communication cycle

3.3.2
cyclic communication
periodic exchange of telegrams

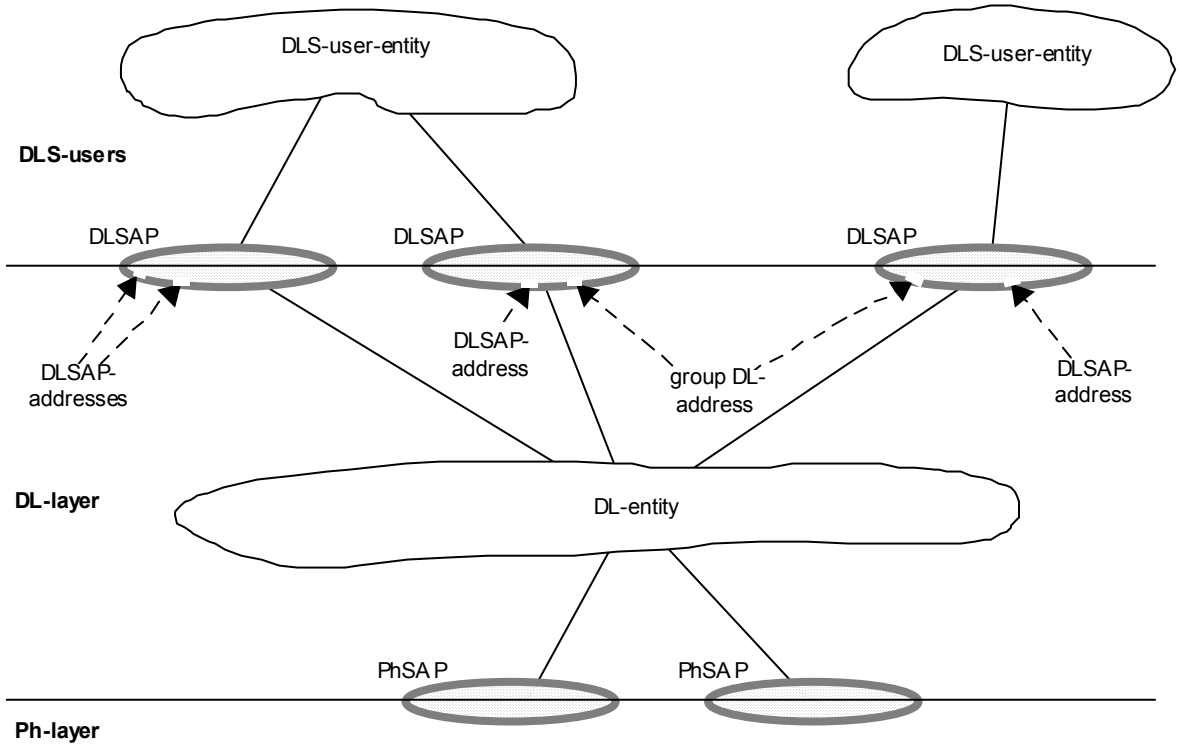
3.3.3
cyclic data
part of a telegram, which does not change its meaning during cyclic operation of the network

3.3.4
cyclic operation
operation in which devices in the communication network are addressed and queried one after the other at fixed, constant time intervals

3.3.5
device
a slave in the communication network, (e.g., a power drive system as defined in the IEC 61800 standard family, I/O stations as defined in the IEC 61131 standard family)

3.3.6
device status
four adjacent octets inside the acknowledge telegram containing status information for each device

3.3.7
DL-segment, link, local link
single DL-subnetwork in which any of the connected DLEs may communicate directly, without any intervening DL-relaying, whenever all of those DLEs that are participating in an instance of communication are simultaneously attentive to the DL-subnetwork during the period(s) of attempted communication



NOTE 1 DLSAPs and PhSAPs are depicted as ovals spanning the boundary between two adjacent layers.

NOTE 2 DL-addresses are depicted as designating small gaps (points of access) in the DLL portion of a DLSAP.

NOTE 3 A single DL-entity may have multiple DLSAP-addresses and group DL-addresses associated with a single DLSAP.

Figure 1 – Relationships of DLSAPs, DLSAP-addresses and group DL-addresses

3.3.8
DLSAP
distinctive point at which DL-services are provided by a single DL-entity to a single higher-layer entity

NOTE This definition, derived from ISO/IEC 7498-1, is repeated here to facilitate understanding of the critical distinction between DLSAPs and their DL-addresses.

3.3.9
DL(SAP)-address
either an individual DLSAP-address, designating a single DLSAP of a single DLS-user, or a group DL-address potentially designating multiple DLSAPs, each of a single DLS-user

NOTE This terminology is chosen because ISO/IEC 7498-3 does not permit the use of the term DLSAP-address to designate more than a single DLSAP at a single DLS-user.

3.3.10
(individual) DLSAP-address
DL-address that designates only one DLSAP within the extended link

NOTE A single DL-entity may have multiple DLSAP-addresses associated with a single DLSAP.

3.3.11
element
part of IDNs – each IDN has 7 elements, whereas each one has a specific meaning (e.g., number, name, data)

3.3.12
extended link
DL-subnetwork, consisting of the maximal set of links interconnected by DL-relays, sharing a single DL-name (DL-address) space, in which any of the connected DL-entities may communicate, one with another, either directly or with the assistance of one or more of those intervening DL-relay entities

NOTE An extended link may be composed of just a single link.

3.3.13
frame
denigrated synonym for DLPDU

3.3.14
group DL-address
DL-address that potentially designates more than one DLSAP within the extended link. A single DL-entity may have multiple group DL-addresses associated with a single DLSAP. A single DL-entity also may have a single group DL-address associated with more than one DLSAP

3.3.15
hot plug
possibility to open the communication network and insert or remove slaves while the network is still in real-time operation

3.3.16
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

3.3.17
node
single DL-entity as it appears on one local link

3.3.18
protocol
convention about the data formats, time sequences, and error correction in the data exchange of communication systems

3.3.19
receiving DLS-user
DL-service user that acts as a recipient of DL-user-data

NOTE A DL-service user can be concurrently both a sending and receiving DLS-user.

3.3.20
sending DLS-user
DL-service user that acts as a source of DL-user-data

3.3.21
service channel (SVC)
non real-time transmission of information upon master request during RT channel

3.3.22
slave
node, which is assigned the right to transmit by the master

3.3.23
station
node

3.3.24
telegram
frame

3.3.25
topology
physical network architecture with respect to the connection between the stations of the communication system

3.4 Symbols and abbreviations

3.4.1 DL-	Data-link layer (as a prefix)
3.4.2 DLC	DL-connection
3.4.3 DLCEP	DL-connection-end-point
3.4.4 DLE	DL-entity (the local active instance of the data-link layer)
3.4.5 DLL	DL-layer
3.4.6 DLPCI	DL-protocol-control-information
3.4.7 DLPDU	DL-protocol-data-unit
3.4.8 DLM	DL-management
3.4.9 DLME	DL-management Entity (the local active instance of DL-management)
3.4.10 DLMS	DL-management Service
3.4.11 DLS	DL-service
3.4.12 DLSAP	DL-service-access-point
3.4.13 DLSDU	DL-service-data-unit
3.4.14 FIFO	First-in first-out (queuing method)
3.4.15 IDN	Identification Number
3.4.16 OSI	Open systems interconnection

3.4.17 Ph- Physical layer (as a prefix)

3.4.18 PhE Ph-entity (the local active instance of the physical layer)

3.4.19 PhL Ph-layer

3.4.20 QoS Quality of service

3.4.21 RE Resource element

3.4.22 RTC Real-time channel

3.4.23 SI Sub Index

3.4.24 SVC Service channel

3.5 Common conventions

This standard uses the descriptive conventions given in ISO/IEC 10731.

The service model, service primitives, and time-sequence diagrams used are entirely abstract descriptions; they do not represent a specification for implementation.

Service primitives, used to represent service user/service provider interactions (see ISO/IEC 10731), convey parameters that indicate information available in the user/provider interaction.

This standard uses a tabular format to describe the component parameters of the DLS primitives. The parameters that apply to each group of DLS primitives are set out in tables throughout the remainder of this standard. Each table consists of up to six columns, containing the name of the service parameter, and a column each for those primitives and parameter-transfer directions used by the DLS:

— the request primitive's input parameters;

— the request primitive's output parameters;

— the indication primitive's output parameters;

— the response primitive's input parameters; and

— the confirm primitive's output parameters.

NOTE The request, indication, response and confirm primitives are also known as requestor.submit, acceptor.deliver, acceptor.submit, and requestor.deliver primitives, respectively (see ISO/IEC 10731).

One parameter (or part of it) is listed in each row of each table. Under the appropriate service primitive columns, a code is used to specify the type of usage of the parameter on the primitive and parameter direction specified in the column:

M — parameter is mandatory for the primitive.

U — parameter is a User option, and may or may not be provided depending on the dynamic usage of the DLS-user. When not provided, a default value for the parameter is assumed.

C — parameter is conditional upon other parameters or upon the environment of the DLS-user.

(blank) — parameter is never present.

Some entries are further qualified by items in brackets. These may be

a) a parameter-specific constraint

(**=**) indicates that the parameter is semantically equivalent to the parameter in the service primitive to its immediate left in the table;

b) an indication that some note applies to the entry

(**n**) indicates that the following note n contains additional information pertaining to the parameter and its use.

In any particular interface, not all parameters need be explicitly stated. Some may be implicitly associated with the DLSAP at which the primitive is issued.

In the diagrams which illustrate these interfaces, dashed lines indicate cause-and-effect or time-sequence relationships, and wavy lines indicate that events are roughly contemporaneous.

4 Data-link services and concepts

4.1 Overview

The data-link layer specifies services for reading and writing data from devices in a Type 16 network. The mechanisms for using these services are related to the Type 16 specific Identification Numbers (IDN). There are three different types of services:

- Service channel services (confirmed, non-cyclic)
- File transfer services (confirmed, non-cyclic)
- Real-time channel setup services (confirmed, non-cyclic)
- Real-time channel services (confirmed, cyclic).

Table 1 gives a Summary of DL services and primitives.

4.1.1 Acknowledged connection oriented data transfer: Read (RD)

This service permits the local DLS-user to send a DLSDU to a single remote station. At the remote station the DLSDU, if the respective DLPDU is transferred error-free, is delivered by the remote DLE to its local DLS-user and answered by it. This response is send back. The originating local DLS-user receives a confirmation answer of the DLSDU by the remote DLS-user. If an error occurred during the transfer, the originating DLE repeats the data transfer up to a configured maximum number of times.

4.1.2 Acknowledged connection oriented data transfer: Read (WR)

This service permits the local DLS-user to send a DLSDU to a single remote station. At the remote station the DLSDU, if the respective DLPDU is transferred error-free, is delivered by the remote DLE to its local DLS-user and answered by it. This response is send back. The originating local DLS-user receives a confirmation answer of the DLSDU by the remote DLS-user. If an error occurred during the transfer, the originating DLE repeats the data transfer up to a configured maximum number of times.

4.1.3 Acknowledged connection oriented data transfer: Initiate_cyclic_communication (ICC)

This service permits the local DLS-user to send a DLSDU to a several remote station. At the remote station the DLSDU, if the respective DLPDU is transferred error-free, is delivered by the remote DLE to its local DLS-user and answered by it. This response is send back. The originating local DLS-user receives a confirmation answer of the DLSDU by the remote DLS-user. If an error occurred during the transfer, the originating DLE repeats the data transfer up to a configured maximum number of times.

4.1.4 Acknowledged connection oriented data transfer: Disable_cyclic_communication (DCC)

This service permits the local DLS-user to send a DLSDU to remote stations. At the remote station the DLSDU, if the respective DLPDU is transferred error-free, is delivered by the remote DLE to its local DLS-user and answered by it. This response is send back. The originating local DLS-user receives a confirmation answer of the DLSDU by the remote DLS-user. If an error occurred during the transfer, the originating DLE repeats the data transfer up to a configured maximum number of times.

4.1.5 Unacknowledged connectionless data transfer: Write_cyclic (WRC)

This service permits a local DLS-user to transfer a DLSDU to a single remote station or a list of stations. The local DLS-user receives a confirmation acknowledging the completion of the transfer, but not whether the DLPDU was duly received. At each addressed remote station this DLSDU, if the respective DLPDU is received error-free, is delivered to a single local DLS-user. There is no confirmation to the sending DLS-user that such an intended delivery has taken place.

4.1.6 Unacknowledged connectionless data transfer: Send_Device_Status (SDS)

This service permits a local DLS-user to transfer a DLSDU to a single remote station . The local DLS-user receives a confirmation acknowledging the completion of the transfer, but not whether the DLPDU was duly received. At the addressed remote station this DLSDU, if the respective DLPDU is received error-free, is delivered to a single local DLS-user. There is no confirmation to the sending DLS-user that such an intended delivery has taken place.

4.1.7 Unacknowledged connectionless data transfer: Write_Device_Status (WDS)

This service permits a local DLS-user to transfer a DLSDU to a single remote station . The local DLS-user receives a confirmation acknowledging the completion of the transfer, but not whether the DLPDU was duly received. At the addressed remote station this DLSDU, if the respective DLPDU is received error-free, is delivered to a single local DLS-user. There is no confirmation to the sending DLS-user that such an intended delivery has taken place.

4.1.8 Acknowledged connection oriented data transfer: File download (FD)

This service permits the local DLS-user to send a DLSDU to remote stations. At the remote station the DLSDU, if the respective DLPDU is transferred error-free, is delivered by the remote DLE to its local DLS-user and answered by it. This response is send back. The originating local DLS-user receives a confirmation answer of the DLSDU by the remote DLS-user. If an error occurred during the transfer, the originating DLE repeats the data transfer up to a configured maximum number of times.

4.1.9 Acknowledged connection oriented data transfer: File download (FD)

This service permits the local DLS-user to send a DLSDU to remote stations. At the remote station the DLSDU, if the respective DLPDU is transferred error-free, is delivered by the remote DLE to its local DLS-user and answered by it. This response is send back. The originating local DLS-user receives a confirmation answer of the DLSDU by the remote DLS-user. If an error occurred during the transfer, the originating DLE repeats the data transfer up to a configured maximum number of times.

Table 1 – Summary of DL services and primitives

Service	Primitive	Possible for these station classes
Acknowledged connection oriented data transfer: Read (RD)	DL-RD request DL-RD confirm	Master
	DL-RD indication DL-RD response	Slave
Acknowledged connection oriented data transfer: Write (WR)	DL-WR request DL-WR confirm	Master
	DL-WR indication DL-WR response	Slave
Acknowledged connection oriented data transfer: Initiate_cyclic_communication (ICC)	DL-ICC request DL-ICC confirm	Master
	DL-ICC indication DL-ICC response	Slave
Acknowledged connection oriented data transfer: Disable_cyclic_communication (DCC)	DL-DCC request DL-DCC confirm	Master
	DL-DCC indication DL-DCC response	Slave
Unacknowledged connectionless data transfer: Write_cyclic (WRC)	DL-WRC request DL-WRC confirm	Master or Slave
	DL-WRC indication	Slave or Master
Unacknowledged connectionless data transfer: Send_Device_Status (SDS)	DL-SDS request DL-SDS confirm	Slave
	DL-SDS indication	Master
Unacknowledged connectionless data transfer: Write_Device_Status (WDS)	DL-WDS request DL-WDS confirm	Master
	DL-WDS indication	Slave
Acknowledged connection oriented data transfer: File download (FD)	DL-FD request DL-FD confirm	Master
	DL-FD indication DL-FD response	Slave
Acknowledged connection oriented data transfer: File upload (FU)	DL-FU request DL-FU confirm	Master
	DL-FU indication DL-FU response	Slave

4.2 Service channel services (SVC services)

With the services of the service channel, a master reads or writes elements of an IDN of a slave device.

4.2.1 Read (RD)

4.2.1.1 Function

With the RD service, a master reads elements of an IDN from one device selected by a device address (see Table 2).

Table 2 – Read (RD)

Parameter name	Request input	Indication output	Response input	Confirmation output
Device address	M	M (=)		
IDN	M	M (=)		
Element	M	M (=)		
Data			M	M (=)
Error code			M	M (=)

NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter. The method by which a response primitive is correlated with its corresponding preceding indication primitive is a local matter. See 1.2.

4.2.1.2 Request and Indication parameters

4.2.1.2.1 Device address

This parameter is used to address the device from which the data is to be read.

4.2.1.2.2 IDN

This parameter is used to identify the IDN from which the data is to beread.

4.2.1.2.3 Element

This parameter is used to identify the element of the IDN that is to be read.

4.2.1.3 Response and confirmation parameters

The result is used to convey the service specific parameters of the service response.

4.2.1.3.1 Data

This parameter specifies the data which was read from the device.

4.2.1.3.2 Error code

This parameter specifies the error code of the read request.

4.2.2 Write (WR)

4.2.2.1 Function

With the Write services a master writes elements of an IDN to one device selected by a device address (see Table 3).

Table 3 – Write (WR)

Parameter name	Request input	Indication output	Response input	Confirmation output
Device address	M	M (=)		
IDN	M	M (=)		
Element	M	M (=)		
Data	M	M (=)		
Error code			M	M (=)

NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter. The method by which a response primitive is correlated with its corresponding preceding indication primitive is a local matter. See 1.2.

4.2.2.2 Request and Indication parameters

4.2.2.2.1 Device address

This parameter is used to address the device to which the data is to be written.

4.2.2.2.2 IDN

This parameter is used to identify the IDN from which the data is to be written.

4.2.2.2.3 Element

This parameter is used to identify the element of the IDN that is to be written.

4.2.2.2.4 Data

This parameter specifies the data which is written to the device.

4.2.2.3 Response and confirmation parameters

The result conveys the service specific parameters of the service response.

4.2.2.3.1 Error code

This parameter specifies the error code of the write request.

4.3 Realtime channel setup services (RTCS services)

With the Realtime channel setup services, a master establishes the cyclic communication.

4.3.1 Initiate_cyclic_communication (ICC)

4.3.1.1 Function

With the ICC service, a master initiates the cyclic communication with the slave devices in a Type 16 network (see Table 4).

Table 4 – Initiate_cyclic_communication (ICC)

Parameter name	Request input	Indication output	Response input	Confirmation output
Baud rate	M	M (=)		
Cycle time	M	M (=)		
List of device addresses	M	M (=)		
List of MS input data length for all devices	M	M (=)		
List of offset of MS input data for all devices	M	M (=)		
List of MS output data length for all devices	M	M (=)		
List of offset MS output data for all devices	M	M (=)		
Error code			M	M (=)

NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter. The method by which a response primitive is correlated with its corresponding preceding indication primitive is a local matter. See 1.2.

4.3.1.2 Request and Indication parameters

4.3.1.2.1 Baud rate

This parameter is used to define the baud rate of the communication.

4.3.1.2.2 Cycle time

This parameter is used to define the cycle time of the communication.

4.3.1.2.3 List of device addresses

This parameter is used to define the addresses of all devices which are included in the cyclic communication.

4.3.1.2.4 List of length of input data for all devices

This parameter is used to define the length of input data for all devices which are included in the cyclic communication.

4.3.1.2.5 List of offsets of input data for all devices

This parameter is used to define the offsets of all devices for transmitting data.

4.3.1.2.6 List of length of output data for all devices

This parameter is used to define the length of output data for all devices which are included in the cyclic communication.

4.3.1.2.7 List of offsets for output data for all devices

This parameter is used to define the offsets of all devices for receiving data.

4.3.1.3 Response and Confirmation parameters

4.3.1.3.1 Error code

This parameter specifies the error code of the initiate request.

4.3.2 Disable_cyclic_communication (DCC)

4.3.2.1 Function

With the DCC service, a master disables the cyclic communication with the slave devices in a Type 16 network (see Table 5).

Table 5 – Disable_cyclic_communication (DCC)

Parameter name	Request input	Indication output	Response input	Confirmation output
List of device addresses	M	M (=)		
Error code			M	M(=)

NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter. The method by which a response primitive is correlated with its corresponding preceding indication primitive is a local matter. See 1.2.

4.3.2.2 Request and Indication parameters

4.3.2.2.1 List of Device Addresses

This Parameter specifies the list of device addresses with which the cyclic communication is to be disabled.

4.3.2.3 Response and Confirmation parameters

4.3.2.3.1 Error code

This parameter specifies the error code of the disable request.

4.4 RTC services

With the services of the real-time channel (RTC), master and slave devices are able to read or write cyclic data. These mechanisms are initiated by the DL-user.

4.4.1 Notify_Error (NER)

4.4.1.1 Function

With the NER service, the DL-user is notified that an error has occurred in a Type 16 network (see Table 6).

Table 6 – Notify_Error (NER)

Parameter name	Indication output
Error code	M

4.4.1.2 Indication parameter

4.4.1.2.1 Error code

This parameter specifies the error code of the communication error occurred.

4.4.2 Write_cyclic (WRC)

4.4.2.1 Function

With the WRC service a device writes the configured cyclic data for the next communication cycle (see Table 7).

Table 7 – Write_cyclic (WRC)

Parameter name	Request input	Indication output	Confirmation output
Device identifier	M	M (=)	
IDN	M	M (=)	
Data		M (=)	
Status			M (=)
NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter. See 1.2.			

4.4.2.2 Request and Indication parameters

4.4.2.2.1 Data identifier

This parameter specifies the cyclic data identifier which is written to the device.

4.4.2.2.2 Data

This parameter specifies the cyclic data which is written to the device.

4.4.2.3 Confirmation parameters

4.4.2.3.1 Error code

This parameter specifies the error code of the write_cyclic request.

4.4.3 Send_Device_Status (SDS)

4.4.3.1 Function

With the SDS service, the status of the local device announced to a remote user (see Table 8).

Table 8 – Get_Device_Status (GDS)

Parameter name	Request input	Indication output	Confirmation output
Device identifier	M	M	
Device Status		M	M (=)
Error code		M	M (=)
NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter. See 1.2.			

4.4.3.2 Request and Indication parameters

4.4.3.2.1 Device identifier

This parameter specifies the device that is to be informed about the local status.

4.4.3.3 Confirmation parameters

4.4.3.3.1 Device status

This parameter specifies the device status which has been identified.

4.4.3.3.2 Error code

This parameter specifies the error code of the send_device_status request.

4.4.4 Write_Device_Status (WDS)

4.4.4.1 Function

With the WDS service, the status of a remote device is set (see Table 9).

Table 9 – Write_Device_Status (SDS)

Parameter name	Request input	Indication output	Confirmation output
Device identifier	M	M	
Device Status	M	M (=)	
Error Code		M	M (=)

NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter. See 1.2.

4.4.4.2 Request and Indication parameters

4.4.4.2.1 Device identifier

This parameter specifies the device identifier of which the status is to be set.

4.4.4.2.2 Device status

This parameter specifies the device status which is to be set.

4.4.4.3 Confirmation parameters

Error code

This parameter specifies the error code of the set_device_status request.

4.4.5 Notify_Network_Status_Change (NNSC)

4.4.5.1 Function

With the NNSC service, the DL-user is notified that a change of the network status has occurred in a Type 16 network (see Table 10).

Table 10 – Notify_Network_Status_Change (NNSC)

Parameter name	Indication output
Network status	M

4.4.5.2 Indication parameters

4.4.5.2.1 Network status

This parameter specifies the network status which has been identified.

4.5 File transmission services

4.5.1 File download (FD)

4.5.1.1 Function

With the FD service, a master transfers a file to a device of a type 16 network (see Table 11).

Table 11 – File download (FD)

Parameter name	Request input	Indication output	Response input	Confirmation output
Device address	M	M (=)		
Data	M	M (=)		
Error code			M	M (=)

NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter. The method by which a response primitive is correlated with its corresponding preceding indication primitive is a local matter. See 1.2.

4.5.1.2 Request and Indication parameters

4.5.1.2.1 Device address

This parameter specifies the device address.

4.5.1.2.2 Data

This parameter specifies the data to be transferred.

4.5.1.3 Response and confirmation parameters

4.5.1.3.1 Error code

This parameter specifies the error code of the file download.

4.5.2 File upload (FU)

With the FU service, a master transfers a file from a device of a type 16 network (see Table 12).

Table 12 – File upload (FU)

Parameter name	Request input	Indication output	Response input	Confirmation output
Device address	M	M (=)		
Data			M	M (=)
ErrorCode			M	M (=)

NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter. The method by which a response primitive is correlated with its corresponding preceding indication primitive is a local matter. See 1.2.

4.5.2.1 Request and Indication parameters

4.5.2.1.1 Device address

This parameter specifies the device address.

4.5.2.2 Response and confirmation parameters

4.5.2.2.1 Data

This parameter specifies the data to be transferred.

4.5.2.2.2 Error code

This parameter specifies the error code of the file download.

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