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INTERNATIONAL STANDARD

Multimedia home network – Network interfaces for network adapter

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MULTIMEDIA HOME NETWORK – NETWORK INTERFACES FOR NETWORK ADAPTER

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

FDIS	Report on voting
100/1354/FDIS	100/1389/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.

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- withdrawn,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.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

There are several obstacles to the spread of networked appliances that can be overcome by the concept of a Network Adapter described in this standard. As Home Networking technology is rapidly evolving, network functions which are pre-installed in home electrical appliances can easily become obsolete and may be difficult to upgrade. Many appliances strictly limit resources such as the CPU, power capacity, and memory to achieve cost savings. If all network functions are embedded in Home Networked appliances, this could result in a higher cost for new appliances and an additional barrier to wide adoption of such systems. In addition, when consumers want to add a new appliance to the network, they are forced to choose equipment with the same interconnecting systems as the existing network or add a router or gateway which can interconnect different systems.

To solve these problems, the network functions are divided into two parts. Since functions from OSI layer 1 to 7 (refer to ISO/IEC 7498 in Bibliography) are necessary to network home electrical appliances (including both multimedia equipment and household appliances such as televisions, computers, refrigerators, washing machines, and sensors), network functions from OSI layer 1 to 6 and most of layer 7 reside in an external Network Adapter and only a small part of layer 7 resides in the home appliances.

The advantages of applying this standard are:

- Users can upgrade a Home Network by simply changing the Network Adapters.

  NOTE 1 For example, when an end-user wants to have higher QoS media.

- An electrical appliance without embedded network functions can be connected to an existing Home Network with a Network Adapter.

  NOTE 2 For example, when an end-user wants to utilize some of the network application functions (i.e. energy conservation, etc) on an appliance which does not have all of the network function integrated.

- By selecting Network Adapters which use the same interconnecting system as the existing Home Network, routers or the gateways can be avoided.

  NOTE 3 For example, when an end-user's network is a powerline network, but the appliance the user wants to connect to has only an RF network connection.

  NOTE 4 For example, when an end-user's network is based on home networking standard "A" (layer 1-7), but the appliance the user wants to connect utilizes a home networking standard "B" (layer 1-7).

- Home appliance manufacturers can produce products that can be connected to Home Networks with minimal cost increases since most of the network functions are not required to be embedded in the appliance.

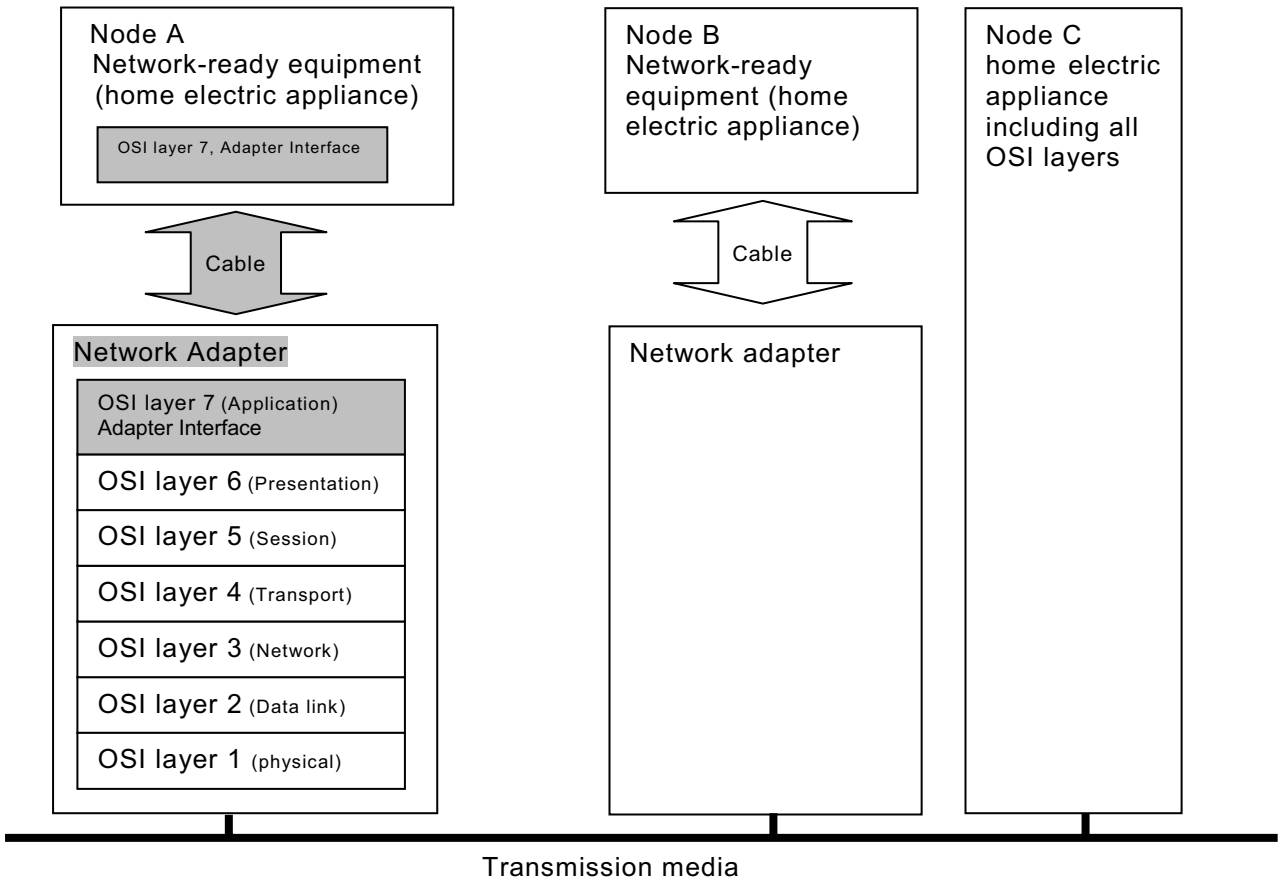
  NOTE 5 This standard is helpful for standardizing the manufacturing process for including the network function in appliances- especially when the market has a low penetration of appliances that are network-ready.

- Device objects are based on the same object-oriented methodology used in almost all existing network protocols.

MULTIMEDIA HOME NETWORK – NETWORK INTERFACES FOR NETWORK ADAPTER

1 Scope

This International Standard specifies the requirements for the characteristics of the Network Adapter itself and the interface between the Network Adapter and Network-ready equipment as shown in Figure 1. Data exchanged between the Network Adapter and Network-ready equipment are basically for HES Class1. This standard does not specify the Home Networking Protocol by OSI layer 1-6 in the Network Adapter and any implementation of the software stack and hardware.



NOTE Gray colored portions are standardized.

Figure 1 – The specified portions

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.

None.

3 Terms and definitions

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

3.1
Application Property Data
ADT
data value related to Application Property Code, such as status notification or specific setting and control; data size, code value, and data format for ADT are specified

3.2
Application Object
AOJ
a model of information to be disclosed to the network from information owned by the communications processing block, or an access procedure model. The information or control target owned by each device is specified as a property, and the operating method (setting, browsing) for this is specified as a service. X1, X2 and X3 are assigned for AOJ code

3.3
Application Property Code
APC
1 octet code for the Application Property of the Application Object

3.4
cold start
method for starting the Home Network node by starting initial setting processing while abandoning previous information related to Network addresses and Application Object data. Cold start (1) re-acquires all information, especially information related to Network addresses, cold start (2) re-acquires only lower layer address, and cold start (3) re-acquires only upper layer addresses. If the address is fixed, cold start (1), cold start (2), and cold start (3) are the same.

3.5
Device object
helps the device operation functions of Application Objects to facilitate status confirmation and control between devices via communications and prepared for appliances such as air conditioner Application Objects, refrigerator objects, etc., with the Application Object definitions for such Application Objects to be specified separately and individually as classes.

3.6
Get/GetM
request for reading the property value of Application Object. Get is for non-element type property values. GetM is for element type property values; in this case, the element number is given

3.7
HES Class1
home electronic systems with transport capabilities for telecontrol applications such as control, monitoring, measurement, alarm and low speed data transfer. These capabilities are typically provided for by single packet-mode, low bandwidth channel and digital transmission

3.8
Home Network
generic name for various equipment-type Home Network standards for mainly household appliances; specifically, it refers to CEBus, Konnex, ECHONET, LonTalk, etc.

3.9
Network Adapter
Network Adapter contains the network functions from OSI layer 1 to 6, most of layer 7 and the Network Adapter communication interface. Network-ready equipment can communicate with a Home Network when connected via a Network Adapter

3.10
Network-ready equipment
network-ready equipment contains part of the network functions of OSI layer 7 and the Network Adapter communication interface. Network-ready equipment cannot function as part of a Home Network unless it is connected with a Network Adapter

3.11
Node
a communication node conforming to a Home Network standard. In a Home Network, this is a Home Network communication function to be uniquely identified by a Network address. There is no distinction between the application functions of nodes. The term node is used to describe the function of one communication terminal on a Home Network. This is referred to as node herein unless otherwise specified.

3.12
Node Profile Object
the Application object that represents Node related data, such as the operating state, manufacturer data, address information, and the Device object list in the node, etc. These are specified to enable manipulation (read/write) by application software and other nodes

3.13
NRZ method
non return to Zero method. This is one of the coding methods, in which 0 corresponds to low level on the signal line, and 1 corresponds to high level on the signal line

3.14
Set/SetM
request for writing the property value of an Application Object. **Set** is for non-element type property values. **SetM** is for element type property values. In the latter case, the element number and setting value are given

3.15
Abbreviations

ADT	Application Property Data
AOJ	Application Object
APC	Application Property Code
CN	Command Number Code
DL	Data Length Code
FCC	Frame Check Code
FD	Frame Data
FN	Frame Number
FT	Frame Type

4 Network Adapter communication interfaces and requirements

4.1 Overview

In this standard, two types of protocol specifications for Network Adapter communication interface software are provided to minimize the burden placed on Network-ready equipment in relation to network-related processing. The first is an object generation type and the second is a peer-to-peer type.

a) Object generation type

AOJ related data are exchanged between the Network Adapter and Network-ready equipment using a standardized communication method. AOJ related data preinstalled in the Network-ready equipment (at least one) is configured in the Network Adapter using a standardized procedure.

b) Peer-to-peer type

AOJ related data are exchanged between the Network Adapter and Network-ready equipment using a vendor-defined communication method. The communication method is not defined in this standard.

One appropriate type for the Network Adapter communication interface is selected after equipment interface data recognition service. Figure 2 shows the Network Adapter communication software hierarchy. Each box in the figure is described later.

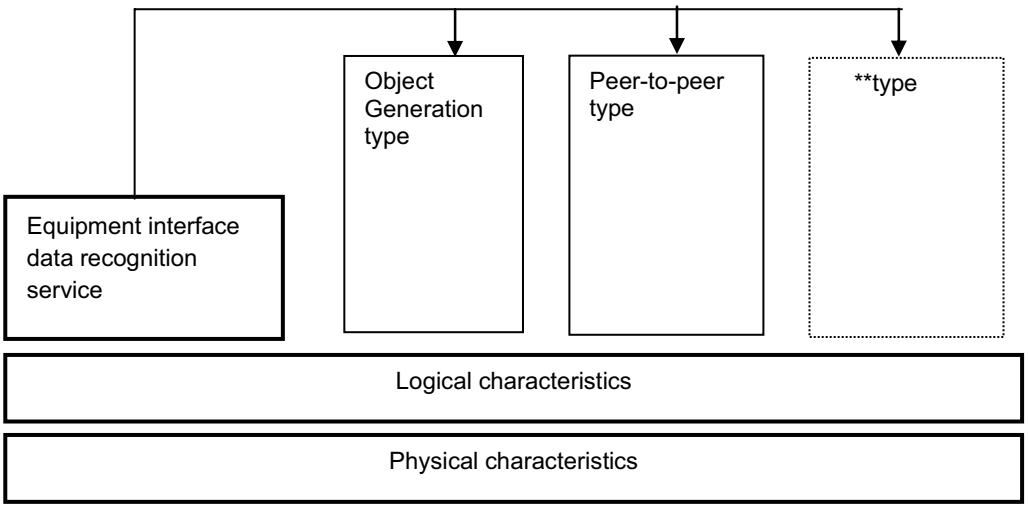


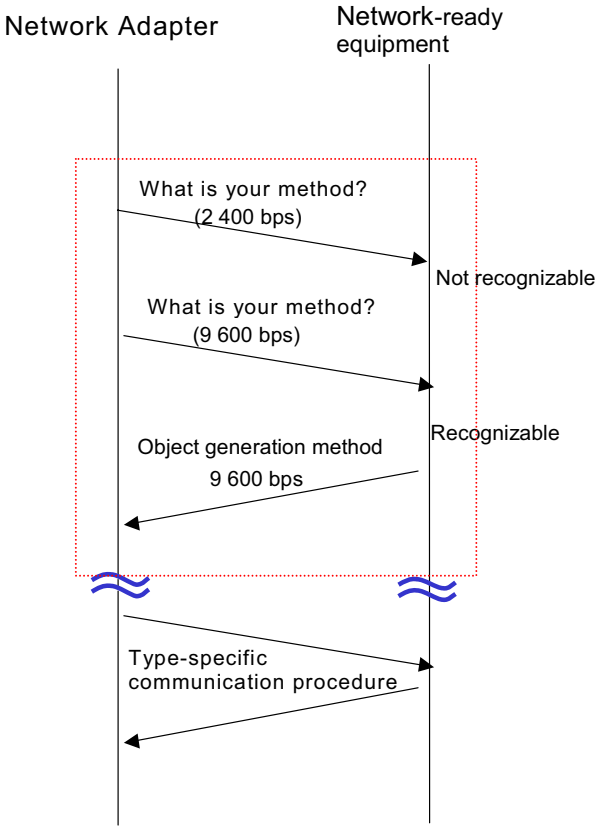
Figure 2 – Network Adapter communication software hierarchy

Table 1 shows examples of acceptable combinations (i.e. combinations with which communication is possible) of types supported by Network Adapters and types supported by Network-ready equipment.

Table 1 – Acceptable combinations of types supported by Network Adapters and types supported by Network-ready equipment

Network Adapter	Network-ready equipment
Object generation type	Object generation type
Peer-to-peer type	Peer-to-peer type

Figure 3 shows an example of an equipment interface data recognition service. The Network Adapter inquires the communication type to the Network-ready equipment at 2 400/9 600 bps.



NOTE 1 The figure shows a case where the Network-ready equipment is capable of handling 9 600 bps communication and object generation method.

NOTE 2 This standard does not define the transmission speed confirmation order.

Figure 3 – Example of the equipment interface data recognition sequence

4.2 Requirement of functions

The four defined functions for a Network Adapter are shown below. All four functions, except for b), shall be required for a Network Adapter as OSI layer 1-7. Only function d) is defined in this standard. All other functions are defined according to the appropriate Home Network protocols. The only function required for Network-ready equipment shall be d).

a) Message input and output function

A function to input and output electronic messages to and from the transmission medium in accordance with the lower-layer communication protocol specifications. This function is performed by lower-layer communication software and, therefore, requires a transceiver capable of handling each Home Network lower-layer communication protocol.

b) Protocol difference absorption function

This function is performed by the protocol difference absorption processing section and allows the necessary conversions to be made between the Home Network lower-layer communication software and Home Network communications processing section protocol.

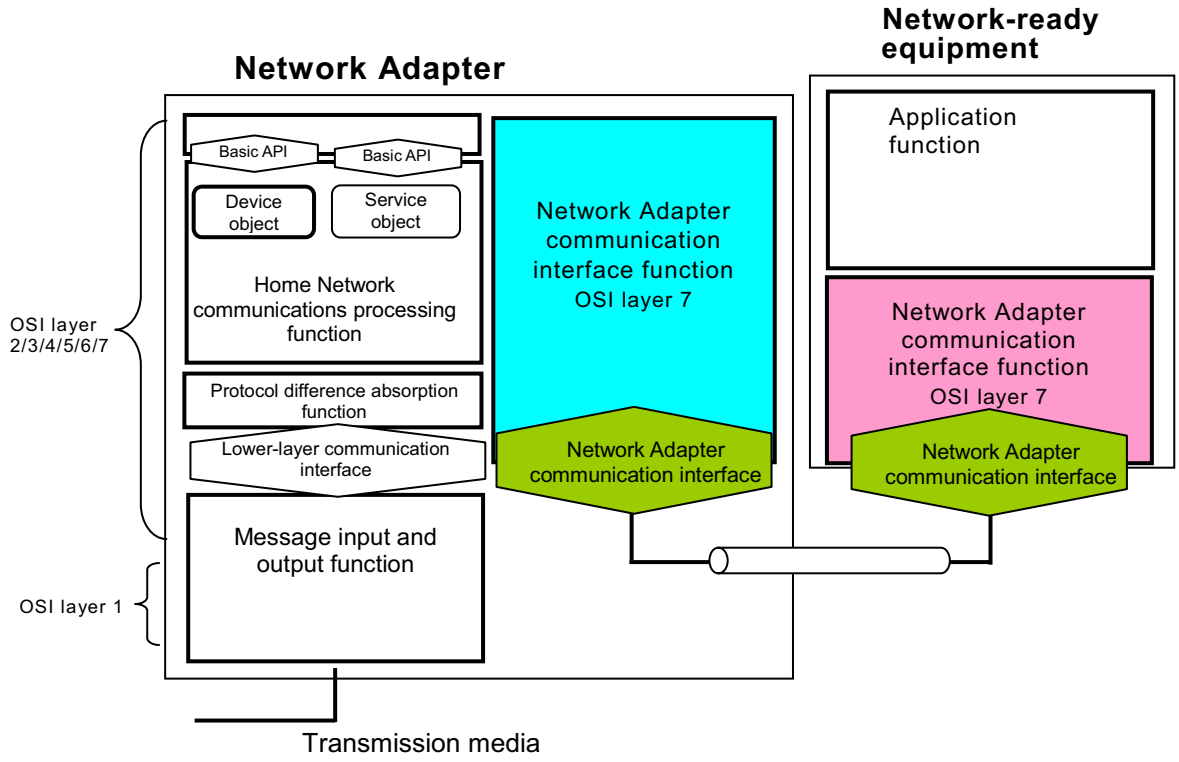
c) Home Network communications processing function

A function to be performed by the communications processing section which handles the transmission frame, objects, etc.

d) Network Adapter communication interface function

This function performs the necessary communications between the Network Adapter and Network-ready equipment and is defined in this standard. It performs communications between the Network-ready equipment application function and the Home Network communications processing function in the Network Adapter.

Figure 4 shows the Network Adapter functions.



NOTE OSI layer diagram corresponds to the left side diagram inside the Network Adapter.

Figure 4 – Network Adapter functions

4.3 Mechanical and physical characteristics for a Network Adapter

Mechanical and physical characteristics for a Network Adapter are defined in 4.3.1 and 4.3.2.

4.3.1 Network Adapter

The shape and display section are specified as below.

a) Shape

Only the connector described in 4.3.2 is defined in this standard.

b) Display section

Where LEDs are provided as a means of indicating the operation status of a Network Adapter, it is recommended that the minimum requirements listed below be satisfied. For status indication using a method not described herein, the specifications for the individual products are used.

- Number of LEDs: one (used to indicate the operation status)
- LED colour: green
- LED status indication

  In operation: ON (solid)

  Initial processing: Slow blinking

  Abnormal state: Rapid blinking

  Not operating: OFF

NOTE 1 Initial processing indicates an unrecognized status as specified in 4.6.1.4

NOTE 2 Slow blinking – repeated on-off sequence with approximately 2 s in the ON state followed by approximately 0,5 s in the OFF state.

NOTE 3 Rapid blinking – repeated ON-OFF sequence with approximately 0,5 s in the ON state followed by approximately 0,5 s in the OFF state.

4.3.2 Network Adapter communication interface

This subclause defines the mechanical and physical characteristics required for Network Adapter communication interface.

a) Transmission medium

The recommended transmission medium for Network Adapter communication interface is as follows:

Eight multi-conductor cables (conductor diameter is not specified).

b) Cable length

In the case of an open collector, the length for which a guarantee is provided shall be 2 m at the maximum.

c) Connection style

One-to-one connection of a Network Adapter and a corresponding piece of Network-ready equipment.

4.4 Electrical characteristics

Electrical characteristics for a Network Adapter is defined in 4.4.1 and 4.4.2.

4.4.1 Network Adapter

The Electrical characteristics required for OSI layer 1-7 are defined according to the appropriate Home Network protocols.

4.4.2 Network Adapter communication interface

This subclause defines the electrical characteristics requirements for Network Adapter communication interface.

a) Cable characteristics impedance

Not specified.

b) Signal transmission speed

For signals used by the equipment interface data recognition service of a Network Adapter communication interface, the two transmission speeds specified below shall be implemented for the Network Adapter. The Network-ready equipment shall be equipped with either of the two transmission speeds.

Transmission speeds: 2 400 bps, 9 600 bps

c) Signal transmission method and waveform of transmitted signals

The signal transmission method and the waveform of transmitted signals shall be as follows (the interface points are the connector pins).

- Transmission method: base band transmission
- Waveform: single-current NRZ method

- Logic level:see Figure 5

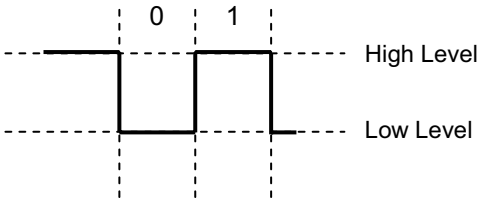


Figure 5 – Logic level

d) Output pin specifications

Type 1 or Type 2 shall be selected.

Type 1: open collector

Type 2: 3,3 V CMOS

e) Specifications for supplying power

Three cla sses are specified for supplying power to Network-ready equipment as shown in the following tables: Table 2; Table 3; and Table 4.One method for supplying power to Network Adapters is specified in Table 5. The supplying and receiving functions are optional for both Network-ready equipment and Network Adapters.

Table 2 – Specifications for supplying power – Network-ready equipment (Class 1)

Supply voltage	4,5 to 15 V
Supply capacity	1 200 mVA or more

Table 3 – Specifications for supplying power – Network-ready equipment (Class 2)

Supply voltage	4,5 to 5,5 V
Supply capacity	300 mVA or more

Table 4 – Specifications for supplying power – Network-ready equipment (Class 3)

Supply voltage	3 to 4,5 V
Supply capacity	300 mVA or more

Table 5 – Specifications for Supplying Power – Network Adapter

Supply voltage	3,0 to 5,5 V
Supply capacity	100 mVA or more

f) Reset

A reset pin (RST) to electrically reset the Network Adapter from the Network-ready equipment shall be implemented in the Network Adapter. Implementation in the Network-ready equipment is optional. The High, Low, and Low → High states of the RST pin shall correspond to normal operation, deactivation of the Network Adapter, and reset start, respectively.

4.5 Logical requirements

Logical requirements for Network Adapters are defined in 4.5.1 and 4.5.2.

4.5.1 Network Adapter

The Logical requirements for OSI layer 1-7 are defined according to the appropriate Home Network protocols.

4.5.2 Network Adapter communication interface

This subclause defines the logical requirements for Network Adapter communication interface.

a) Control method

The control method shall be a RTS/CTS-based method. RTS shall correspond to signals to notify the other side that transmission will be started or that no message can be received and CTS shall correspond to signals that the other side sends either to indicate its status as to whether or not messages can be received or to notify that it will start communicating. The RTS/CTS control procedure for transmitting an electronic message shall be as follows:

- If no message can be received, RTS is set to High Level. If messages can be received, RTS is set to Low Level.
- A check is made before transmission to confirm that CTS is Low Level.

  (No message is sent if CTS is High Level.)
- Data are output to TXD.

Service requests shall be handled in the order they are transmitted. In the event of a service request collision, the service request from the Network Adapter shall be handled first. A CTS status change during a frame transmission shall not require the sending side to abort transmission of the frame. If the sending side aborts transmission of the frame, that frame shall be considered invalid and the prescribed subsequent processing shall be performed. RTS/CTS function is required for the Network Adapter side and is optional for the Network-ready equipment side.

b) Synchronization method

Synchronization shall be achieved using a character-by-character start-stop synchronization method. The following requirements shall be satisfied:

- Character composition (see Figure 6) A total of 11 bits

  Start bit (ST): 1 bit

  Data: 8 bits

  Parity: 1 bit

  Stop bit (STP): 1 bit
- Data transmission order: LSB first
- Start bit: logical 0
- Stop bit: logical 1
- Parity: even number parity

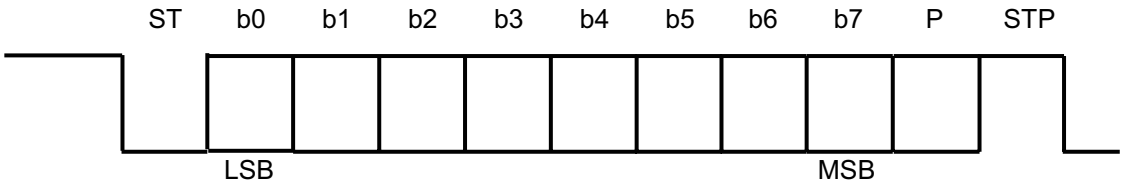


Figure 6 – Character composition

c) Timing requirements

The timing requirements for execution of the Network Adapter communication software protocols are as shown in Figure 7 and Table 6. The Network Adapter sends a request frame and the Network-ready equipment receives it and sends back a response frame, vice versa.

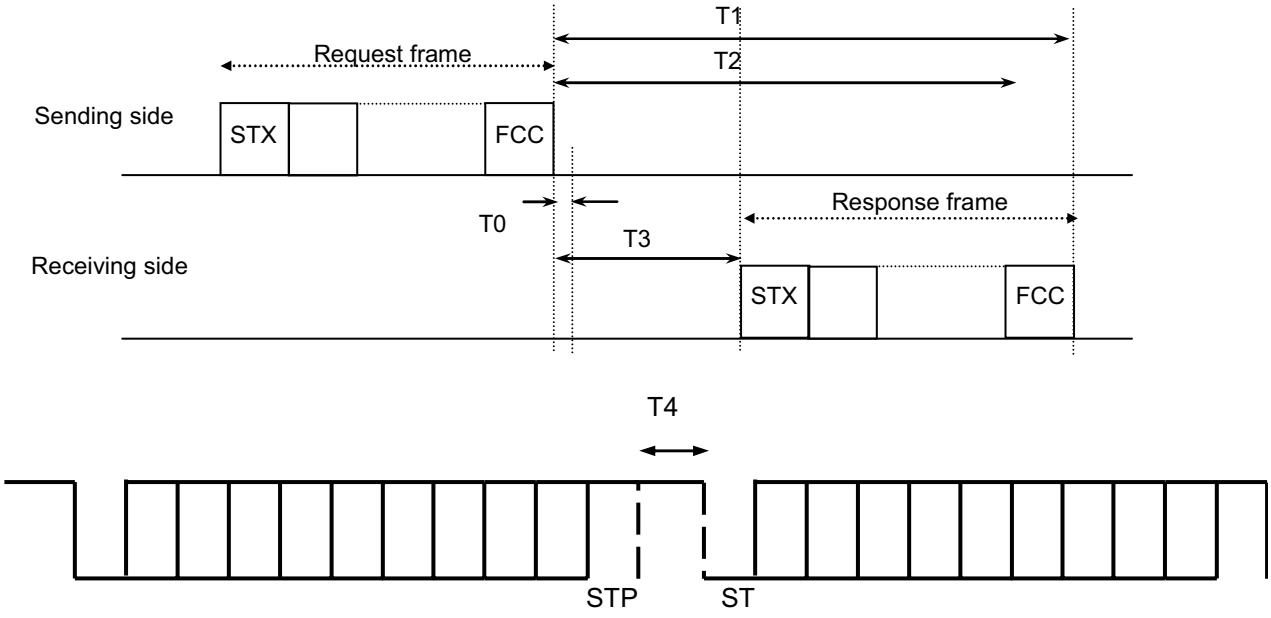


Figure 7 – Timing requirements

Table 6 – Timing requirements

Symbol	Name	Requirement
T0	Receiving side frame synchronization confirmation (frame completion / start position detection)	9 600 bps or less: No message is received for 10 ms or more. More than 9 600 bps: No message is received for a period equal to 3-character composition length or more.
T1	Response waiting timeout	300 ms from the end of the frame sent by itself
T2	Retransmission inhibition time	300 ms from the end of the frame sent by itself
T3	Response transmission inhibition time (T4 confirmation time)	9 600 bps or less: 10 ms or more More than 9 600 bps: a period equal to 3-character composition length or more
T4	Sending side character composition interval	9 600 bps or less: less than 10 ms More than 9 600 bps: less than a period equal to 3-character composition length

d) Control code (STX)

Header code. This shall be fixed at 0x02.

e) Data part (DATA)

The data part shall be the part sandwiched between the Network Adapter communication interface STX and the FCC. The specific content varies depending on what type is selected for the Network Adapter communication interface (for details, refer to 4.6).

f) Check code (FCC)

The check code, which is used to detect frame transmission errors, shall be the 2's complement of the total value of the characters contained in the data part.

g) Frame completion detection

If, after a stop bit is detected, the start bit of the next character is not detected for a period that is shorter than 3 field lengths (this period shall be 10 ms in the case of a transmission speed that is less than 9 600 bps), it is assumed that transmission of the frame has completed.

h) Error detection

The receiving terminal shall detect the following types of errors:

- Octet reception errors

  Each octet shall have a parity bit. Even number parity shall be used. If a parity error is detected while receiving an octet during a frame reception session, the receiving terminal shall consider the frame being received as an invalid frame and discard it (the frame shall be discarded upon completion of reception or upon reception timeout).

- FCC errors

  An FCC check shall be made every time the reception of a frame is completed. FCC shall be the 2's complement of the sum of the content of the data part.

  If the FCC code is valid, the frame shall be considered a valid frame.

  If the FCC code is invalid, the frame shall be considered invalid and discarded.

i) Error control

No ACK/NAK error control shall be provided.

4.6 Network Adapter communication software protocols

The Network Adapter communication software protocol differs depending on the type of Network Adapter. The requirements for each of the following three protocols are defined in the following sections, with one section dedicated to each:

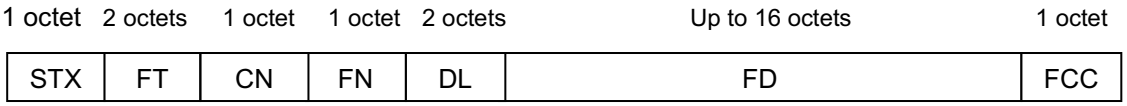
- Equipment interface data recognition service software protocol;
- Communication software protocol for object generation type
- Communication software protocol for peer-to-peer type

4.6.1 Equipment interface data recognition service software protocol

This section provides the service specifications for recognizing the equipment interface data of Network-ready equipment connected to a Network Adapter.

4.6.1.1 Frame composition

Figure 8 shows the frame composition for executing the equipment interface data recognition service. The frame type code (FT), command number code (CN), frame number code (FN), data length code (DL), and frame data (FD) sections comprise the Network Adapter communication interface protocol data.



- STX (control code)

Header code. For equipment interface data recognition service software protocols, this shall be fixed at 0x02.

- FT

Indicates the frame type. Frames for equipment interface data recognition shall be fixed at 0xFFFF.

- CN

The command number code shall be a 1-octet code that specifies a defined service (equipment interface data recognition service software protocols for Network Adapter communication interface).

- FN

A number assigned by the requesting side (0x01 to 0xFF). A response frame shall have the same number as the corresponding request frame. For Network-ready equipment that is not designed to use frame numbers, this shall be fixed at 0x00.

- DL

The data length code shall be a 2-octet code that indicates the size of the frame data (FD) section that follows. The size shall be measured in octets and be expressed using hexadecimal notation. For this service, the maximum value of a DL shall be 0x0010. The data order shall be big-endian.

- FD

The frame data section is a field of data that is defined by the frame type (FT) and command number code (CN). The data order for data having 2 octets or more shall be big-endian. The specific composition shall be defined on a CN-by-CN basis.

- FCC

A 1-octet check code shall be used as the frame check code.

Figure 8 – Format of equipment interface data recognition service

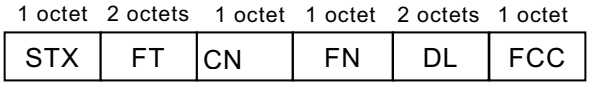
4.6.1.2 Commands

This subclause describes the commands used for the equipment interface data recognition service for each of the Network Adapter communication interface.

a) Equipment interface data request and response commands (required)

This sequence is shown in Figure 13. These commands shall be used to allow the Network Adapter to acquire information on the type of Network Adapter communication interface implemented in the Network-ready equipment. First, the Network Adapter shall send an equipment interface data request to the Network-ready equipment until the equipment interface data response is received, with repetitive attempts using two speeds A and B. The

order in which the available speeds are repeated, the number of attempts, and the interval (minimum T1 in Figure 7) are beyond the scope of these specifications. The optimal method for the characteristics of the Network Adapter will be used. If an equipment interface data response is received and communication in accordance with that response is possible, the Network Adapter shall move to the equipment interface data recognition notification service. The direction of request commands is from the Network Adapter to the Network-ready equipment. Figure 9 below shows the format of request command.



STX: 0x02

FT: 0xFFFF

CN: 0x00

FN: 0x**

DL: 0x0000

FCC: 0x**

Figure 9 – Format of request command

Figure 10 below shows the format of response command.

1 octet	2 octets	1 octet	1 octet	2 octets	1 octet	1 octet	0 or 8 octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FD(1)	FD(2)	FCC

STX: 0x02

FT: 0xFFFF

CN: x80

FN: Value at the time of the request (0x00 if the function is not implemented)

DL: n + 2

FD(0): type of Network Adapter

b0	b1	b2	b3	b4	b5	b6	b7
*	*	0	0	0	0	0	0

b2 to b7: Reserved for future use (fixed at 0)

b1: Object generation type (0: not present, 1: present)

b0: Peer-to-peer type implementation (0: not present, 1: present)

FD(1): transmission speed

0x00	2 400 bps
0x01	4 800 bps
0x02	9 600 bps
0x03	19,2 Kbps
0x04	38,4 Kbps
0x05	57,6 Kbps
0x06	115 Kbps
0x07– 0xFF	Not defined (reserved for future use)

FD(2): Method-specific definition area (n octets)

– Object generation type: Not present (0 octet)

– Peer-to-peer type (8 octets)

FD(2)			
1 octet	3 octets	2 octets	2 octets
Interface data	Manufacturer code	AOJ code	Type code

Interface data (1 octet)

b0	b1	b2	b3	b4	b5	b6	b7
*	*	*	*	*	*	*	*

b7, b6: Communication sequence

b7, b6: 0, 1= Adapter polling

1, 1= Bidirectional

1, 0 & 0,0= Not defined

b5: Flow control: 0= without, 1= with
b4: ACK/NAK response: 0= without, 1= with
b3: Downloading: 0= without, 1= with
b2 to b0: Not defined

Manufacturer code (3 octets)
- defined by each Home Network Standard Association/Consortium if required
AOJ code (2 octets)
- AOJ code of the AOJ in the Network-ready equipment
Type code (2 octets)
- defined by each manufacturer

FCC: 0x**

Figure 10 – Format of response command

b) Equipment interface data recognition notification command and equipment interface data recognition notification acceptance response command (required)

This sequence is shown in Figure 13.The Network Adapter shall notify the Network-ready equipment if it can handle the communication method specified by the Network-ready equipment using an equipment interface data recognition notification. This notification shall be made within 300 ms (Ti) after the receipt of the equipment interface data response. If the Network Adapter can handle the communication method specified by the Network-ready equipment, it shall so notify and wait for an equipment interface data recognition notification acceptance response. If the Network Adapter cannot handle the communication method specified by the Network-ready equipment, it shall so notify and enter the connection not possible state. Upon receipt of an equipment interface data recognition notification, the Network-ready equipment shall check the content of the notification. If the value indicates that the Network Adapter can handle the communication method specified by the Network-ready equipment, the Network-ready equipment shall send an equipment interface data recognition notification acceptance response to the Network Adapter within 300 ms (Ti) and enter the unconfirmed state. If the value indicates that the Network Adapter cannot handle the communication method specified by the Network-ready equipment, the Network-ready equipment shall wait for an equipment interface data request. If the Network Adapter receives an equipment interface data recognition notification acceptance response within 300 ms (Ti) after the transmission of an equipment interface data recognition notification, it shall enter the unconfirmed state. If the Network Adapter does not receive an equipment interface data recognition notification acceptance response within 300 ms (Ti) after the transmission of an equipment interface data recognition notification, it shall send an equipment interface data request again. The direction of request commands is from Network Adapter to Network-ready equipment.

Figure 11 below shows the format of request command.

1 octet	2 octets	1 octet	1 octet	2 octets	1 octet	1 octet
STX	FT	CN	FN	DL	FD(0)	FCC

STX: 0x02

FT: 0xFFFF

CN: 0x01

FN: 0x**

DL: 0x0001

FD(0):Result

0x01: Not supported
0x00: Supported
0x02:Current speed OK, but Request speed NG
0x11:Peer to Peer type acceptable
0x12:Object construction type acceptable
Others: Not defined (reserved for future use)

FCC: 0x**

Figure 11 – Format of request command

Figure 12 below shows the format of response command.

1 octet	2 octets	1 octet	1 octet	2 octets	1 octet
STX	FT	CN	FN	DL	FCC

STX: 0x02

FT: 0xFFFF

CN: 0x81

FN: Value at the time of the request (0x00 if the function is not implemented)

DL: 0x0000

FCC: 0x**

Figure 12 – Format of response command

4.6.1.3 Equipment interface data recognition service sequence

Figure 13 shows the total operation sequence of this service. Figure 14 shows how the Network Adapter and Network-ready equipment change their states. As shown in these figures, both the Network Adapter and Network-ready equipment shall stay in the unrecognized state until the equipment interface data recognition service has been successfully executed. Successive attempts to execute the equipment interface data recognition service shall be made using one (available) transmission speed after another until the Network-ready equipment's communication method is confirmed (recognized). The equipment interface data recognition service shall use that method for communication thereafter. If either the Network-ready equipment or the Network Adapter are reset after a start, a system shall be provided to perform an appropriate recovery action (such as repeating attempts) for each communication method. The Network-ready equipment or the Network Adapter, as the case may be, shall shift to the unrecognized state, as shown in Figure 14, when an unsuccessful communication state (such as that due to imperfect synchronization) is detected and the intended result is not achieved. The transition time to shift to the respective

method (= T_{trans}, see Figure 13) after an equipment interface data recognition service shall be 500 ms or more.

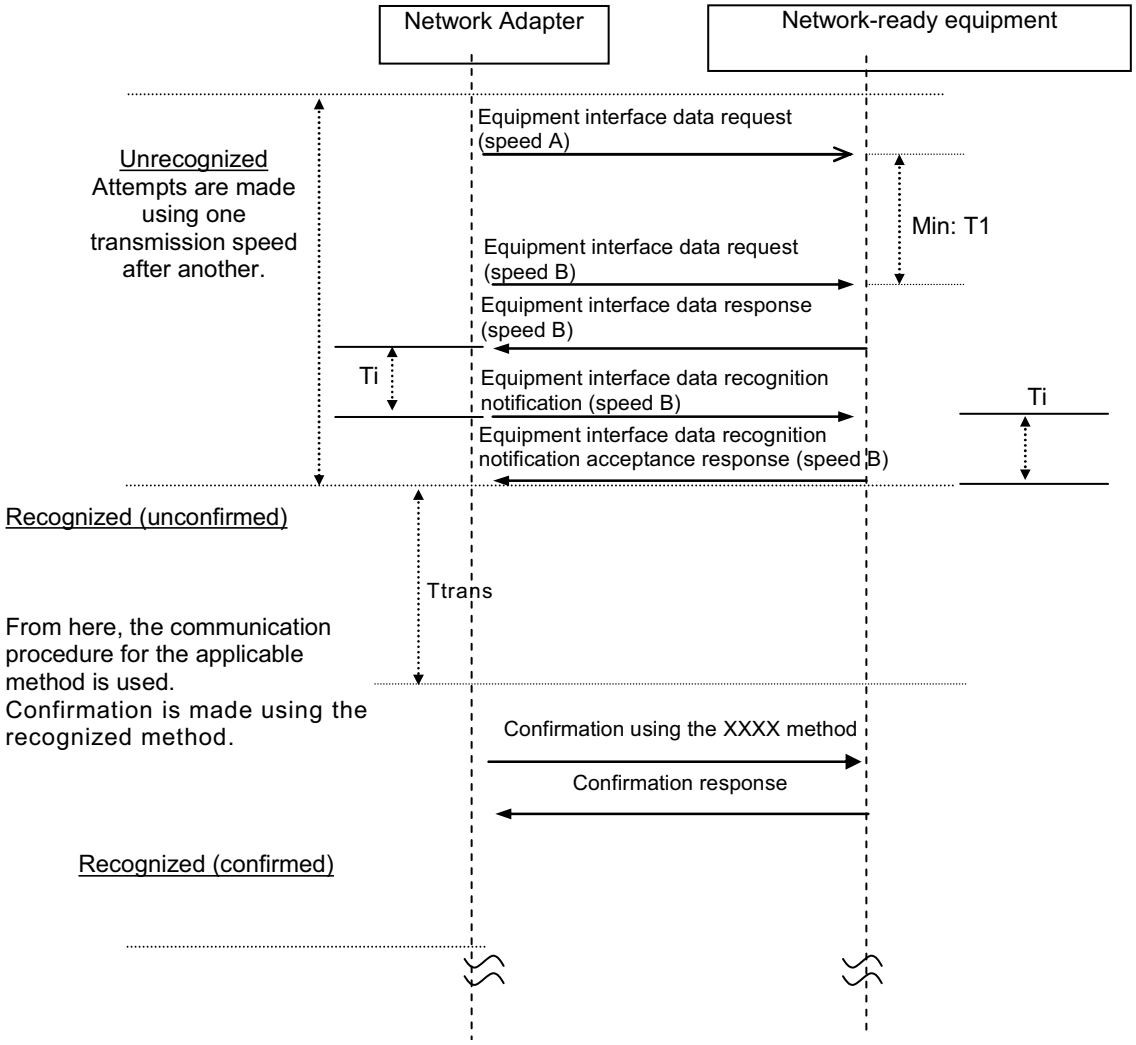


Figure 13 – Sequence of equipment interface data recognition service

4.6.1.4 Status change diagram for all types

The following five states are defined below: recognized, unrecognized, unconfirmed, confirmed, and connection not possible. The recognized state consists of the unconfirmed and confirmed states. The status change and definition of each state follows in Figure 14 and Table 7. The unsuccessful communication state is specified by the communication procedure for the respective communication protocol. The Network Adapter may perform the confirmation processing again upon detection of an unsuccessful communication state. Whether to start from the unrecognized state or from the recognized state upon power-on is determined based on the implementation.

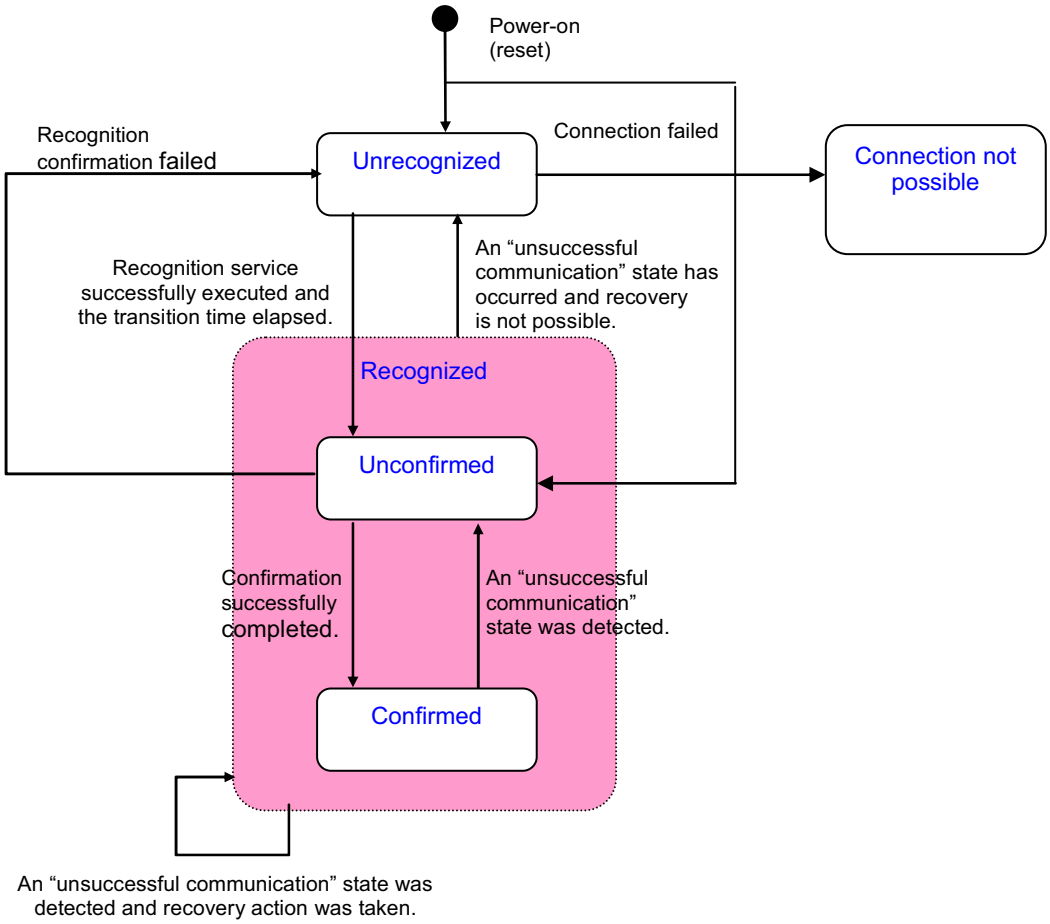


Figure 14 – Status change diagram

Table 7 – Definition of states

State	Definition		Notes
Unrecognized	The process of recognizing that the communication method has not been completed. After the detection of an unsuccessful communication state.	Network-ready equipment side: Waiting for a recognition service request from the Network Adapter. If the equipment interface data recognition notification from the Network Adapter indicates that the Network Adapter cannot handle the communication method specified by the Network-ready equipment, the Network-ready equipment will wait for an Equipment interface data request. If the Network Adapter can handle the communication method specified by the Network-ready equipment, the Network-ready equipment will send an equipment interface data recognition notification acceptance response and enter the unconfirmedu state.	
		Network Adapter side: When attempting to make a recognition service request to the Network-ready equipment, the Network Adapter continues to make attempts on an as-available basis at certain intervals until the recognition process is completed, with repetitive attempts using two speeds A and B. If an equipment interface data response is received and communication in accordance with that response is possible, an Equipment interface data recognition notification is sent to the Network-ready equipment to notify, and after receiving the corresponding acceptance response, the unconfirmed state is entered. If communication using the received information is not possible, an equipment interface data recognition notification is sent to the Network-ready equipment to notify and the connection not possible state is entered.	The order in which the available speeds are repeated, the number of attempts and the interval (minimum T1 in Figure 7) are beyond the scope of these specifications. The optimal method for the characteristics of the Network Adapter is used.
Connection not possible	The state to which a shift is made if there is no communication method that is acceptable to both the Network Adapter and the Network-ready equipment.	The communication not possible abort processing is performed.	

State		Definition		Notes
Recognized	Un-con-firm-ed	The communication method recognition process has been completed and communication is being performed using the communication procedure for the applicable method.	Whether or not it is possible to communicate successfully using the communication procedure for the applicable method has not been confirmed. Network Adapter side: Confirmation is made using the confirmation method for the applicable method.	If, after detecting an unsuccessful communication state and performing an appropriate recovery processing, recovery is not possible, a shift to the unrecognized state shall be made.
	Con-fir-med		It has been confirmed that communication is possible using the communication procedure for the applicable method.	

4.6.1.5 Error processing

If a state should occur that falls under any one of items a) to c) below, the Network Adapter shall give the Node profile object or Device object a setting value indicating the occurrence of such an abnormal state and make an error announcement to the other nodes.

a) Communication not possible

The equipment interface data recognition service has determined that communication with the Network-ready equipment is not possible. After setting the error property (APC = 0x89) of the Node profile object to 0x03E9 (Network Adapter recognition error), the error status property (APC = 0x88) is set to 0x41.

b) Setting error

The setting of a parameter during the confirmed state has failed and it has been determined that continuing the setting operation is not possible. The error property (APC = 0x89) of the Node profile object is set to one of the three values listed below depending on the error-causing factor, and the error status property (APC = 0x88) is set to 0x41. The factors that are considered as error-causing factors differ among communication methods.

Error code:

0x03EA: Object error

0xE3EB: Adapter initialization error

0x03EC: Other setting error

c) Unsuccessful communication

Cases in which communication with the Network-ready equipment is not possible during the confirmed state. After setting the Device object error property (APC = 0x89) for the equipment in question to 0x03E9 (unsuccessful communication), the error status property (APC = 0x88) is set to 0x41. The definition of unsuccessful communication state differs among communication methods.

4.6.2 Communication software protocol for object generation type

This subclause defines the communication software protocol for cases in which the communication interface between the Network Adapter and Network-ready equipment is an object generation type interface.

Network Adapters are divided into the following two types:

- basic Network Adapter, and
- advanced Network Adapter.

An advanced Network Adapter shall be capable of handling address information on other nodes located in the network on the Network Adapter interface; however, a basic Network Adapter is not capable of handling such address information. An advanced Network Adapter shall also be capable of distinguishing whether or not there is a vacancy in relation to elements before handling array properties. In addition to the above-mentioned advanced Network Adapter functions, an advanced Network Adapter shall have all the functions required for a basic Network Adapter.

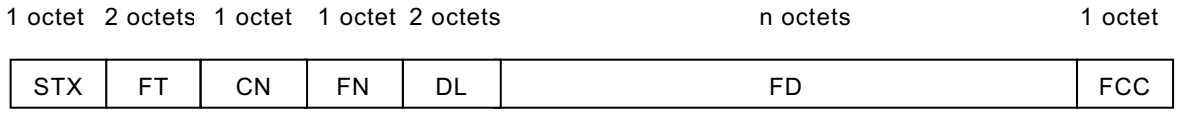
If a basic Network Adapter is connected to a piece of Network-ready equipment that demands processing which corresponds to an advanced Network Adapter, the Network-ready equipment shall satisfy the following requirements.

- The Network-ready equipment indicates that the status of other nodes cannot be referenced or altered. The method of the indication is not stipulated (LED, LCD, etc.).
- Notifications to be sent with the addressees specified are sent as simultaneous broadcasting notifications.
- Responses to requests from other nodes are sent using basic Network Adapter communication frames.

This standard defines the requirements for basic Network Adapters including the necessary support for advanced Network Adapters. A basic Network Adapter shall be capable of (1) internally generating and managing at least three Device objects, and (2) providing at least 1 kB of memory as the domain to store property values in case of implementing three Device objects. In cases where the Network Adapter generates and manages four or more Device objects, an optional command shall be used and 2 kB of memory shall be set aside as the domain to store property values.

4.6.2.1 Frame composition

Figure 15 specifies the composition of the frame for object generation type commands. The frame type code (FT), command number code (CN), frame number code (FN), data length code (DL), and frame data (FD) sections comprise the Network Adapter communication interface protocol data. The composition shown in Figure 15 is the same as that for the equipment interface data recognition command format.



- STX

  Control code. This shall be fixed at 0x02.

- FT

  Indicates the frame type.

  b15 to b12: version
  Indicates the frame version number. This shall be 0000.
  b11 to b8: Reserved for future use (0000)
  b7 to b0: type
  Indicates the frame type for various commands.
  0x00: Equipment interface data confirmation frame
  0x01: Adapter initialization frame
  0x02: Object construction frame
  0x03: Basic regular Home Network frame
  0x04: Reserved for future use for extended Home Network frame
  0x05 to 0xDF: Reserved for future use
  0xE0 to 0xFE: User defined area
  0xFF: Error notification frame

  NOTE 0xFFFF is for the equipment interface data recognition frame.

- CN

  The command number code (CN) shall be a 1-octet code that specifies a defined service (object generation type software protocols for Network Adapter communication interface). This version defines the commands shown in Table 8. The CN with no command name assigned shall be reserved for future use.

- FN

  A number shall be assigned by the requesting side (0x01 to 0xFF), according to the order. A response frame shall have the same number as the corresponding request frame. For Network-ready equipment that is not designed to use frame numbers, this shall be fixed at 0x00.

- DL

  The data length code shall be a 2-octet code that indicates the size of the FD section that follows. The size shall be measured in octets and be expressed using hexadecimal notation. For example, if the FD section has 20 octets, the DL is 0x0014, which indicates 20 octets. The data order shall be big-endian.

- FD

  The frame data section is a field of data that is defined by FT and CN. The data order for data having 2 octets or more shall be big-endian. The specific composition shall be defined on a CN-by-CN basis.

- FCC

  A 1-octet check code shall be used as the frame check code.

Figure 15 – Format of object generation type commands

Table 8 – Object generation type interface command codes

FT	CN	Command name	Implement-ation
Equipment interface data confirmation mode Equipment interface data confirmation frame (0x0000) is used	0x00	Equipment interface data confirmation request	Required
	0x80	Equipment interface data confirmation response	Required
Adapter initialization mode Adapter initialization frame (0x0001) is used	0x01	Adapter initialization setting request	Required
	0x81	Adapter initialization setting response	Required
	0x02	Adapter initialization completion notification	Required
	0x82	Adapter initialization completion notification acceptance response	Required
Object construction mode Object construction frame (0x0002) is used	0x00	Equipment inquiry request	Required
	0x80	Equipment inquiry response	Required
	0x01	Equipment inquiry completion notification	Required
	0x81	Equipment inquiry completion notification acceptance response	Required
	0x02	Adapter start-up notification	Required
	0x82	Adapter start-up notification acceptance response	Required
	0x03	Equipment inquiry request with object designation	Optional[*1]
	0x83	Response to Equipment inquiry request with object designation	Optional[*1]
Home Network communication mode Basic regular Home Network frame (0x0003) is used	0x10	Equipment status access request	Required
	0x90	Equipment status access response	Required
	0x11	Equipment status notification request	Required[*2]
	0x91	Equipment status notification response	Required
	0x12	Element designation equipment status access request	Required
	0x92	Element designation equipment status access response	Required
	0x13	Element designation equipment status notification request	Required[*2]
	0x93	Element designation equipment status notification response	Required
	0x14	Object access request	Required[*2]
	0x94	Object access response	Required
	0x20	Equipment status access request (all)	Optional
	0xA0	Equipment status access response (all)	Optional
	0x21	Equipment status access request (all, UP)	Optional
	0xA1	Equipment status access response (all, UP)	Optional
	0x22	Equipment status notification request (all)	Optional
	0xA2	Equipment status notification response (all)	Optional
	0x23	Object access request (all)	Optional
	0xA3	Object access response (all)	Optional

NOTE 1 Required when the number of Device objects to be generated is four or more.

NOTE 2 Optional for the Network-ready equipment side.

4.6.2.2 Internal services of Network Adapters

For Network Adapters, property values can be specified to be stored in the Network Adapter or passed through the Network Adapter for real-time handling. This can be specified on a property-by-property basis. Therefore, this subclause defines internal services for Network Adapters that instruct the Network Adapter on how to handle services received from other nodes such as Set/SetM (equipment status alteration) and Get/GetM (equipment status confirmation). These internal services are IASet, IASetup, IASetM, IASetMup, IAGet, IAGetup, IAGetM and IAGetMup. When a Set is received, an IASet or IASetup shall be performed and when a SetM is received, an IASetM or IASetMup shall be performed. When a Get is received, an IAGet or IAGetup shall be performed and when a GetM is received, an IAGetM or IAGetMup shall be performed.Table 9 shows the classification of internal services.

Table 9 – Classification of internal services

a) Services that store values in the Network Adapter To reduce the communication load on the Network-ready equipment, responses are made by the Network Adapter.	IASet, IASetM, IAGet, IAGetM
b) Services that do not store values in the Network Adapter Properties for which real-time handling is required are passed through the Network Adapter and responses are made by the Network-ready equipment.	IASetup, IASetMup, IAGetup, IAGetMup

Whether to use an a) or b) service in Table 9 can be specified on a property-by-property basis (acquired as equipment inquiry data from the Network-ready equipment by means of an object construction command). IASetM and IAGetM are not specified in this version.

4.6.2.2.1 IASet/IASetM

IASet/IASetM is an internal service for Network Adapters whereby a Network Adapter that receives a request for a Set/SetM from another node writes the specified values into the corresponding areas of the Device object(s) contained in the Network Adapter. The reception (acceptance) response to the other node shall be made upon completion of the writing process. If no property exists, a rejection response shall be sent back to the other node. Network-ready equipment references the Device object(s) of the Network Adapter at regular intervals to confirm the contents of status alteration requests from other nodes. Figure 16 shows how this works.

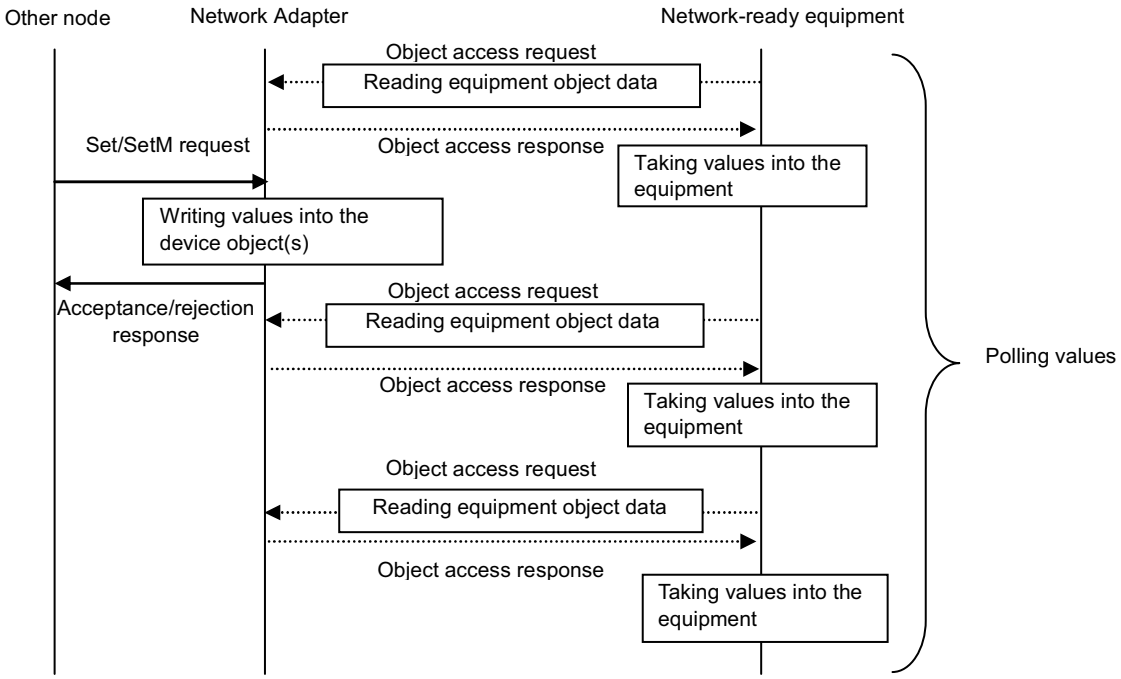


Figure 16 – Operation of IASet (IASetM)

4.6.2.2.2 IASetup/IASetMup

IASetup/IASetMup is an internal service for Network Adapters. When a Network Adapter receives a request for a Set/SetM from another node, it shall inform the contents of the request (status acquisition request) to the Network-ready equipment. The reception (acceptance) response to the other node shall be made upon reception of a status alteration

response sent by the Network-ready equipment in response to the IASetup. Figure 17 shows how this works. If no equipment status access response (element designation equipment status access response in the case of an IASetMup) is returned, a timeout shall occur and a rejection response shall be sent back to the other node. If no property exists, a rejection response shall be sent back to the other node without making an equipment status access request. Figure 17 shows how this works.

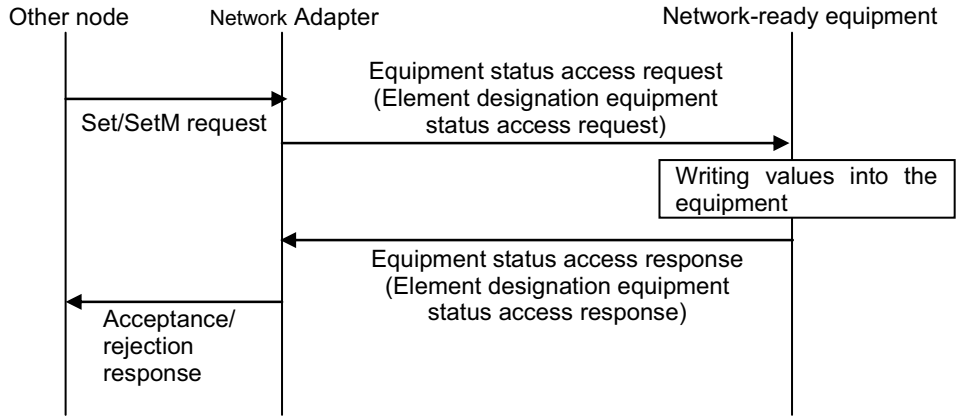


Figure 17 – Operation of IASetup (IASetMup)

4.6.2.2.3 IAGet/IAGetM

IAGet/IAGetM is an internal service for Network Adapters. When a Network Adapter receives a request for a Get/GetM from another node, it shall respond with the specified values in the corresponding areas of the Device object(s) contained in the Network Adapter. The Network-ready equipment shall change the corresponding property values of the Device object(s) of the Network Adapter every time its own status changes. If no property exists, a rejection response shall be sent back to the other node. Figure 18 shows how this works.

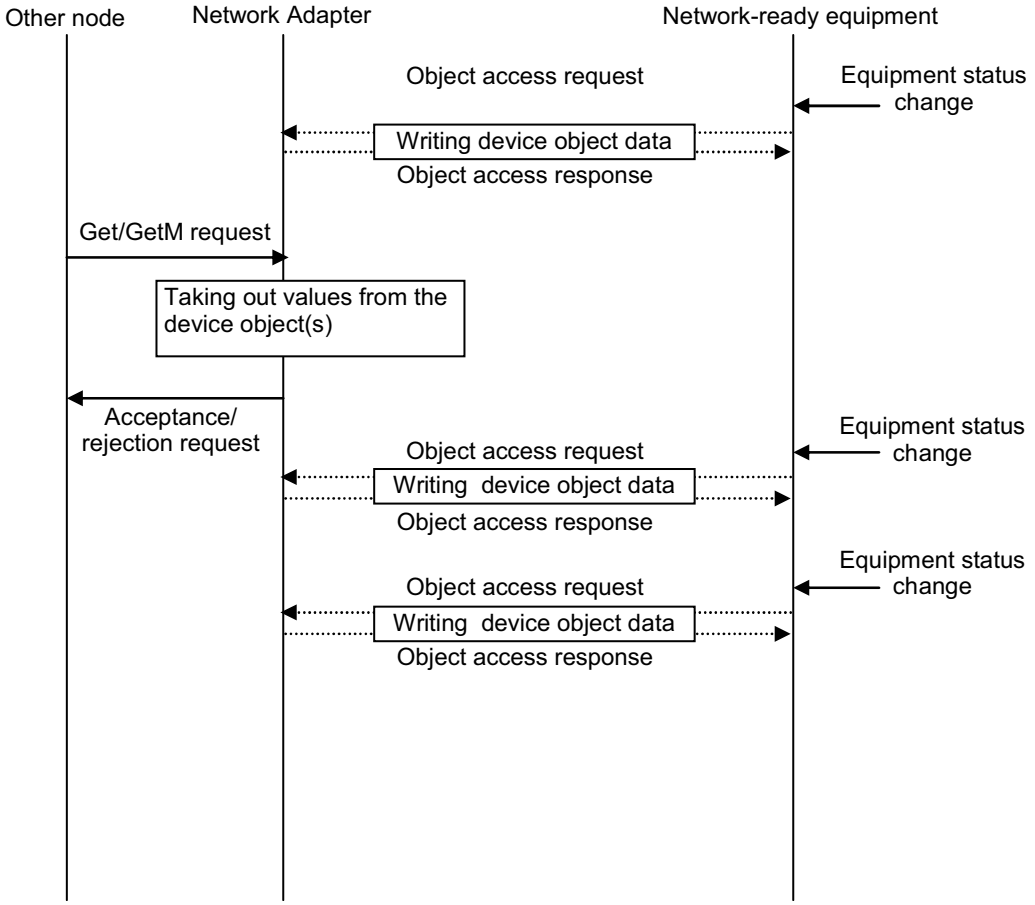


Figure 18 – Operation of IAGet (IAGetM)

4.6.2.2.4 IAGetup/IAGetMup

IAGetup/IAGetMup is an internal service for Network Adapters. When a Network Adapter receives a request for a Get/GetM from another node, it shall inform the contents of the request (status alteration request) to the Network-ready equipment. The response providing values to the other node shall be made upon reception of the response with the corresponding property values from the Network-ready equipment. If no property exists, a rejection response shall be sent back to the other node without making an equipment status access request. Figure 19 shows how this works.

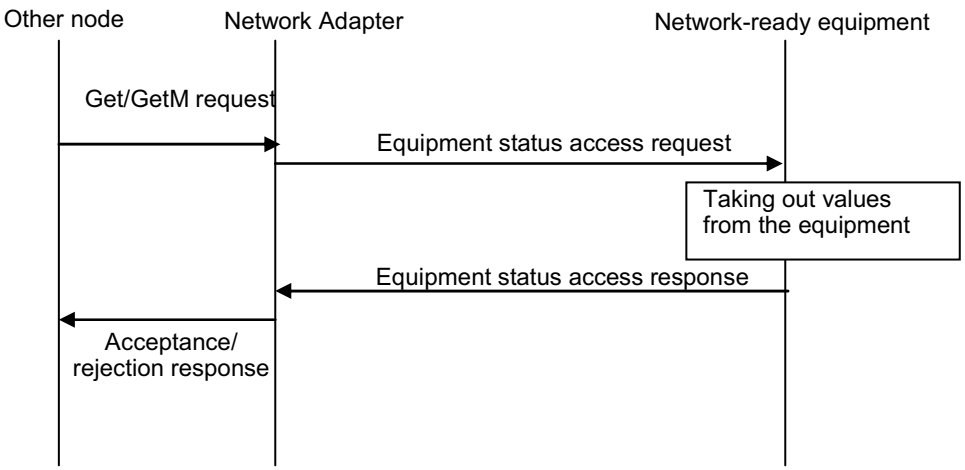


Figure 19 – Operation of IAGetup (IAGetMup)

4.6.2.3 Status change diagram for Network Adapter

This subclause defines the Network Adapter status changes for cases in which an object generation type method is implemented for the Network Adapter communication interface. Figure 20 shows each status and the status change. The Network Adapter shall not perform the processing to join the network until the process of internal object generation is completed. Each state is defined as follows.

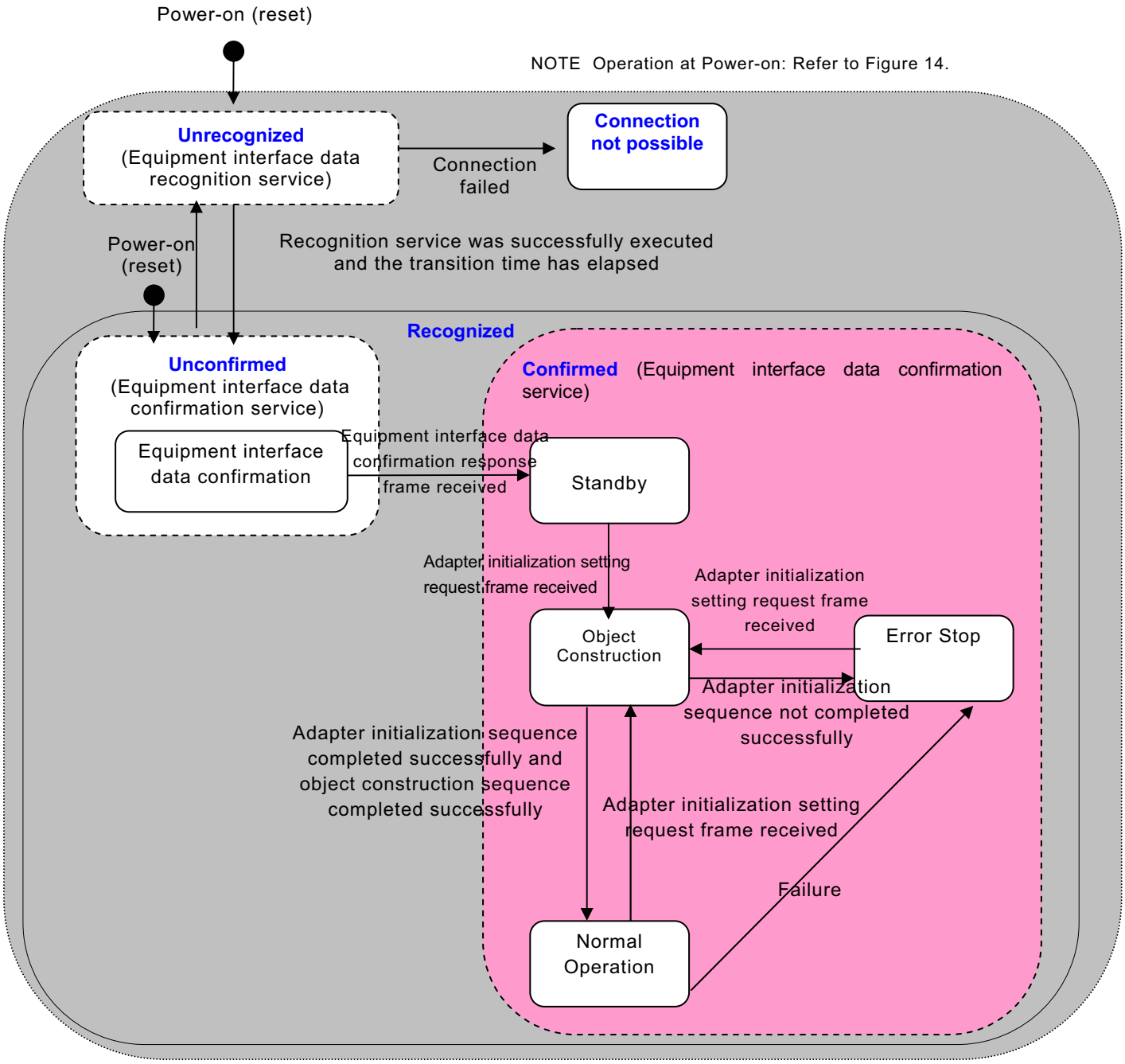


Figure 20 – Network Adapter status changes

4.6.2.3.1 Equipment interface data confirmation state

The Network Adapter enters this state immediately after power-on, after receiving an external reset input, or immediately after completion of the recognition process of the equipment interface data recognition service. The Network Adapter shall remain in this state until the equipment interface data confirmation processing by the equipment interface data confirmation service is completed. The return status discrepancy error shall be sent except those related to the equipment interface data confirmation processing frame and all inputs from the network shall be discarded. After completion of the equipment interface data confirmation processing, the Network Adapter shall shift to the standby state. If the equipment interface data confirmation processing ends abnormally for the specified number of times (=3), a shift shall be made to the unrecognized state.

4.6.2.3.2 Standby state

The state when a Network Adapter is waiting for an adapter initialization setting request frame after the completion of Device object,or when a Network Adapter has completed the equipment interface data confirmation with the Network-ready equipment. The return status discrepancy error shall be sent except those related to the Network Adapter initialization setting request frame and all inputs from the network shall be discarded.

4.6.2.3.3 Object construction state

The Network Adapter enters this state from the standby error stop, or normal operation state by receiving an Adapter initialization setting request frame input, and this state is performing the initialization for the Network Adapter and object construction sequence. The return status discrepancy error shall be sent except those related to the adapter initialization setting mode and object construction mode and all inputs from the network shall be discarded. The Network Adapter then shall perform a communication middleware cold start while the object construction sequence is performed. If the Network Adapter's initialization sequence and the object construction sequence are completed successfully, the Network Adapter shall shift to the normal operation state. If either of these ends abnormally, a shift to the error stop state shall be made.

4.6.2.3.4 Error stop state

The Network Adapter shall shift to the error stop state when either the Network Adapter's initialization sequence fails or a failure occurs during the normal operation state. Upon a shift to this state, the error processing described in 4.6.1.5 shall be performed. The value to be set for the error property shall depend on the cause of the Error Stop state. The relationships between the shift-causing factors and error codes are as follows:

- Failed object construction: 0x03EA (object error)
- Failed adapter initialization sequence: 0x03EB (adapter initialization error)
- Failure during normal operation: 0x03EC (other setting error)

4.6.2.3.5 Normal operation state

The Network Adapter state occurs upon successful completion of the object construction sequence during the object construction state. If properties that need initial values exist, the Network Adapter shall acquire them by issuing the equipment status access request command to the Network-ready equipment. Normal Home Network communication shall be possible only in this state. Object construction mode-related frames shall not be accepted during this state.

4.6.2.4 Commands

This subclause defines the requirements for the commands used for object generation type methods for Network Adapter communication interface.

4.6.2.4.1 Equipment interface data confirmation mode

a) Equipment interface data confirmation request and response commands (required)

The Network Adapter shall make an inquiry to the Network-ready equipment to confirm the objects and communication method for the equipment adapter interface. If no object exists, an inquiry using 0 for the number of objects shall be made. The Network-ready equipment shall respond after confirming a match of the Network Adapter type and object(s).The direction of request commands is from Network Adapter to Network-ready equipment. Figure 21 shows the format of request command.

1 octet	2 octets	1 octet	1 octet	2 octets	1 octet	1 octet	n+1 octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FD(1)	FD(2)	FCC

STX: 0x02

FT: 0x0000

CN: 0x00

FN: 0x**

DL: 0x****

FD(0): Network Adapter type

0x01: Peer-to-peer method

0x02: Object generation method

0x03 to 0xFF: Not defined (reserved for future use)

FD(1): Transmission speed

0x00	2 400 bps
0x01	4 800 bps
0x02	9 600 bps
0x03	19,2 Kbps
0x04	38,4 Kbps
0x05	57,6 Kbps
0x06	115 Kbps
0x07– 0xFF	Not defined (reserved for future use)

FD(2): Area for defining AOJs in Network Adapter (0 to n+1 octets)

n = 18* <number of AOJs>. If there is no AOJ, this shall be 0 octets.

<number of AOJs><AOJ code><manufacturer code><product code>

Listed by the set of each AOJ (max. 3 sets)

NOTE Manufacturer code (3 octets) is defined by each Home Network Standard Association/Consortium if required.product code (12 octets) is defined by each manufacturer.

FCC: 0x**

Figure 21 – Format of request command

Figure 22 shows the format of response command.

1 octet	2 octets	1 octet	1 octet	2 octets	2 octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FCC

STX: 0x02

FT: 0x0000

CN: 0x80

FN: Value at the time of the request (If the function is not implemented, this shall be 0x00.)

DL: 0x0001

FD(0): Processing result

Value of FD(0)	Meaning
0x0000	Normal completion
0x0011	Adapter type mismatch error
0x0012	AOJ mismatch error
0x0021	Equipment interface data discarded
0xFFFF	Other error

FCC: 0x**

Figure 22 – Format of response command

4.6.2.4.2 Adapter initialization mode

a) Adapter initialization setting request and response commands (required)

The Network-ready equipment shall request the basic Network Adapter to initialize the communication middleware and the layers below the middleware. Initialization shall be either a cold start (1), cold start (2), or cold start (3). In cases where there is already a Device object held, selection shall be possible between retaining it (equipment data retention cold start (1), equipment data retention cold start (2), or equipment data retention cold start (3)) and discarding it (equipment data disposal cold start (1), equipment data disposal cold start (2), or equipment data disposal cold start (3)).The basic Network Adapter shall make a shift from the standby state to the object construction state upon reception of an Adapter initialization setting request. The direction of request commands is from Network-ready equipment to the Network Adapter.

Figure 23 shows the format of request command.

1 octet	2 octets	1 octet	1 octet	2 octets	2 octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FCC

STX: 0x02

FT: 0x0001

CN: 0x01

FN: 0x** (0x00 if the function is not implemented)

DL: 0x0002

FD(0): Initialization method

Value of FD(0)	Meaning
0x0001	Equipment data retention cold start (2) If the basic Network Adapter already contains a Device object, the Network Adapter performs a cold start (2) with the AOJ retained (no subsequent Equipment inquiry request is made; upon completion of the cold start (2), the basic Network Adapter makes a shift to the communication state). If no Device object exists, an equipment inquiry request is made, and after completion of the Device object generation process, a cold start (2) is performed.
0x0002	Equipment data disposal cold start (2) If the basic Network Adapter already contains a Device object, the Network Adapter performs a cold start (2) with the AOJ discarded. Then, an Equipment inquiry request is made, and after completion of the Device object generation process, a cold start (2) is performed.
0x0003	Equipment data retention cold start (1) If the basic Network Adapter already contains a Device object, the Network Adapter performs a cold start (1) with the AOJ retained (no subsequent equipment inquiry request is made; the basic Network Adapter immediately makes a shift to the communication state). If no Device object exists, an equipment inquiry request is made, and after completion of the Device object generation process, a cold start (1) is performed.
0x0004	Equipment data disposal cold start (1) If the basic Network Adapter already contains a Device object, the Network Adapter performs a cold start (1) with the AOJ discarded. Then, an equipment inquiry request is made, and after completion of the Device object generation process, a cold start (1) is performed.
0x0005	Equipment data retention cold start (3) If the basic Network Adapter already contains a Device object, the Network Adapter performs a cold start (3) with the object retained (no subsequent equipment inquiry request is made; the basic Network Adapter immediately makes a shift to the communication state). If no Device object exists, an equipment inquiry request is made, and after completion of the Device object generation process, a cold start (3) is performed.
0x0006	Equipment data disposal cold start (3) If the basic Network Adapter already contains a Device object, the Network Adapter performs a cold start (3) with the object discarded. Then, an equipment inquiry request is made, and after completion of the Device object generation process, a cold start (3) is performed.
0x0007-0xFFFF	Reserved for future use

FCC: 0x**

Figure 23 – Format of request command

Figure 24 below shows the format of response command.

1 octet	2 octets	1 octet	1 octet	2 octets	2 octets	1octet	8 octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FD(1)	FD(2)	FCC

STX: 0x02

FT: 0x0001

CN: 0x81

FN: Value at the time of the request

DL: 0x0002 / 0x000B

FD(0): Response result

Value of FD(0)	Meaning
0x0000	Initialization accepted
0x0011	Initialization rejected
0x0101	Status discrepancy error (equipment interface confirmation state (unconfirmed))
0xFFFF	Other error

FD(1): Lower-layer communication software ID

0x11 – 0x1F Lighting line
0x31 – 0x3F Designated low-power radio
0x41 – 0x4F Extended HBS
0x51 – 0x5F IrDA Control
0x61 – 0x6F LonTalk®
0x71 – 0x7F Bluetooth™
0x81 – 0x8F Ethernet
0xFF Generation using random numbers of Unique number field
0x00 Unique number field not been set

FD(2): Unique number field

Hardware address for media address

FCC: 0x**

Figure 24 – Format of response command

b) Adapter initialization completion notification command and Adapter initialization completion notification acceptance response command (required)

The basic Network Adapter shall send an Adapter initialization completion notification to the Network-ready equipment upon completion of a cold start. If the initialization is completed successfully, initialization completed successfully shall be sent. If the initialization ends abnormally, initialization ended abnormally shall be sent to the Network-ready equipment. The Network-ready equipment shall return an Adapter initialization completion notification acceptance response when it receives an Adapter initialization completion notification. The direction of request commands is from Network Adapter to Network-ready equipment. Figure 25 shows the format of request command.

1 octet	2 octets	1 octet	1 octet	2 octets	2 octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FCC

STX: 0x02

FT: 0x0001

CN: 0x02

FN: 0x**

DL: 0x****

FD(0): Response result

Value of FD(0)	Meaning
0x0000	Initialization completed successfully
0x0011	Initialization ended abnormally

FCC: 0x**

Figure 25 – Format of request command

Figure 26 shows the format of response command.

1 octet	2 octets	1 octet	1 octet	2 octets	2 octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FCC

STX: 0x02

FT: 0x0001

CN: 0x82

FN: Value at the time of the request (0x00 if the function is not implemented)

DL: 0x0002

FD(0): Response result

Value of FD(0)	Meaning
0x0000	Initialization completed successfully
0xFFFF	Other error

FCC: 0x**

Figure 26 – Format of response command

4.6.2.4.3 Object construction mode

a) Equipment inquiry request and response commands (required)

When a basic Network Adapter does not contain a Device object, it shall make an equipment inquiry request to the Network-ready equipment. Upon receipt of this request, the Network-ready equipment shall return the equipment data in the form of an equipment inquiry response. The Network-ready equipment that receives an equipment inquiry request shall return, in the form of an equipment inquiry response to the basic Network Adapter, the data necessary to construct Device objects in the basic Network Adapter. The maximum number of Device objects that can be constructed shall be three. Information on three pieces of equipment can be sent in a single response or divided into two or three pieces and sent in two or three

responses, respectively. The direction of request commands is from Network Adapter to Network-ready equipment.

Figure 27 shows the format of request command.

1 octet	2 octets	1 octet	1 octet	2 octets	1 octet
STX	FT	CN	FN	DL	FCC

STX: 0x02

FT: 0x0002

CN: 0x00

FN: 0x**

DL: 0x0000

FCC: 0x**

Figure 27 – Format of request command

Figure 28 shows the format of response command.

1 octet	2 octets	1 octet	1 octet	2 octets	2 octets	1 octet	*octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FD(1)	FD(2)	FCC

STX: 0x02

FT: 0x0002

CN: 0x80

FN: Value at the time of the request (0x00 if the function is not implemented)

DL: 0x****

FD(0): Response result

0x0000: Normal

0xFFFF: Other error

FD(1): Number of AOJs sent in the frame (number of AOJs included in the equipment inquiry response frame)

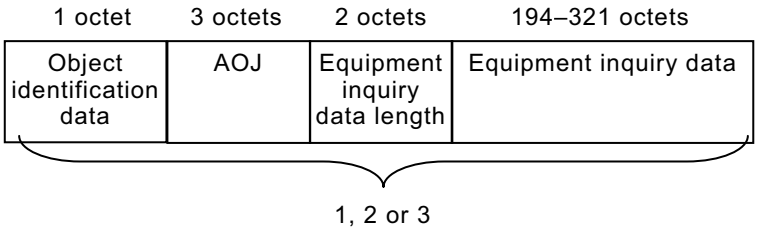
FD(2): Object data

Refer to Object data format of Figure 29.

FCC: 0x**

Figure 28 – Format of response command

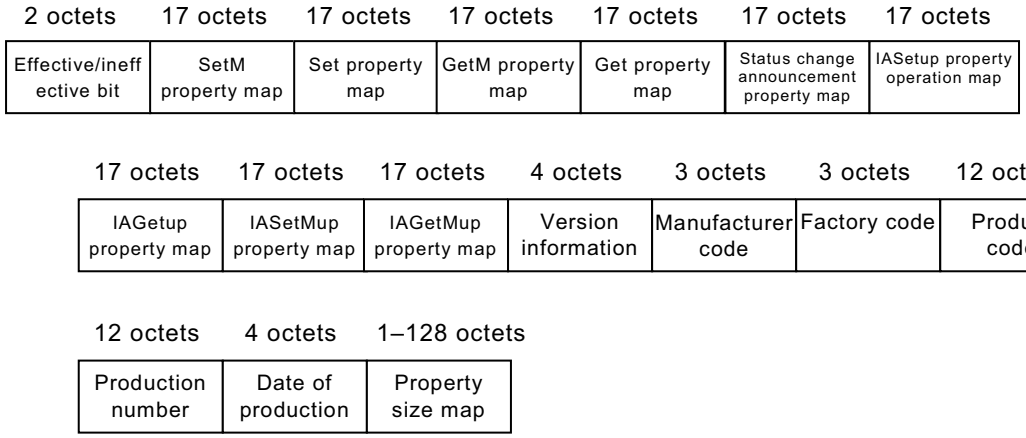
Figure 29 shows the format of object data.



Name	Size (in octets)	Explanation
Object identification data	1	Total number of AOJs to be managed and identification number(s) assigned to manage the AOJ(s). b7 to b4: Total number of AOJs (1: 0001, 2: 0010, 3: 0011) b3 to b0: AOJ identification numbers (1: 0001, 2: 0010, 3: 0011)
AOJ	3	AOJ code generated.
Equipment inquiry data length	2	Indicates the size of the equipment inquiry data.
Equipment inquiry data	194–321	Refer to equipment inquiry data format.

Figure 29 – Format of object data

Figure 30 shows the format of equipment inquiry data.



Name	Size (in octets)	Explanation
Effective/ineffective bit map	2	Indicates the meaningful part in the data that follows: b15: SetM property map b14: Set property map b13: GetM property map b12: Get property map b11: Status change announcement property map b10: IASetup property operation map b9: IAGetup property operation map b8: IASetMup property operation map b7: IAGetMup property operation map b6: Version information b5: Manufacturer code b4: Factory code b3: Product code b2: Production number b1: Date of production b0: Property size map The items set to 1 are effective.
SetM property map	17	Indicates the property that accepts SetM. See the format in Annex C.
Set property map	17	Indicates the property that accepts Set. See the format in Annex C
GetM property map	17	Indicates the property that accepts GetM. See the format in Annex C.
Get property map	17	Indicates the property that accepts Get. See the format in Annex C.
Status change announcement property map	17	Indicates the property that performs status change announcements. See the format in Annex C.
IASetup property operation map	17	Indicates the internal service of the Network Adapter for the property that accepts Set. The Set for the property that was specified as an effective one shall become IASetup. The process of reflecting it in the AOJ is performed after the status alteration on the Network-ready equipment side. Then the response is returned. See the format in Annex C.
IAGetup property operation map	17	Indicates the internal service of the Network Adapter for the property that accepts Get. The Get for the property that was specified as an effective one shall become IAGetup. The process of reflecting it in the AOJ is performed after the status alteration on the Network-ready equipment side. Then the response is returned. See the format in Annex C.
IASetMup property operation map	17	Indicates the internal service of the Network Adapter for the property that accepts SetM. The SetM for the property that was specified as an effective one shall become IASetMup. The process of reflecting it in the AOJ is performed after the status alteration on the Network-ready equipment side. Then the response is returned. See the format in Annex C

Name	Size (in octets)	Explanation
IAGetMup property operation map	17	Indicates the internal service of the Network Adapter for the property that accepts GetM. The GetM for the property that was specified as an effective one shall become IAGetMup. The process of reflecting it in the AOJ is performed after the status alteration on the Network-ready equipment side. Then the response is returned. See the format in Annex C.
Version information	4	Indicates the specification version used.
Manufacturer code	3	Indicates the code defined by each Home Network standard Association/Consortium if required for the Network-ready equipment.
Factory code	3	Indicates the vendor-dependent code that indicates the factory that manufactured the Network-ready equipment.
Product code	12	Indicates the vendor-dependent Network-ready equipment product code.
Production number	12	Indicates the vendor-dependent Network-ready equipment production number.
Date of production	4	Indicates the date on which the Network-ready equipment was manufactured.
Property size map	1 to 128	Indicates the size of each property in octets. In the case of an array property, shall be the product of the size of one array element and the maximum number of array elements. For the properties that are present, the sizes are listed starting from the one with the smallest APC.

Figure 30 – Format of equipment inquiry data

b) Equipment inquiry completion notification command and equipment inquiry completion notification acceptance response command (required)

The basic Network Adapter shall send an equipment inquiry completion notification to the Network-ready equipment when it receives the information to construct all the Device objects. If there is something wrong in the data received through the equipment inquiry response, invalid shall be returned and a shift shall be made to the error stop state. Upon reception of an equipment inquiry completion notification, the Network-ready equipment shall return an equipment inquiry completion notification acceptance response to the basic Network Adapter. If an equipment inquiry completion notification containing invalid is received, the initialization sequence shall be redone. The direction of request commands is from Network Adapter to Network-ready equipment. Figure 31 shows the format of request command.

1 octet	2 octets	1 octet	1 octet	2 octets	2 octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FCC

STX: 0x02

FT: x0002

CN: 0x01

FN: 0x**

DL: 0x0002

FD(0): Equipment inquiry processing result

Value of FD(0)	Meaning
0x0000	OK
0x0011	Invalid

FCC: 0x**

Figure 31 – Format of request command

Figure 32 shows the format of response command.

1 octet	2 octets	1 octet	1 octet	2 octets	2 octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FCC

STX: 0x02

FT: 0x0002

CN: 0x81

FN: Value at the time of the request (0x00 if the function is not implemented)

DL: 0x0002

FD(0): Response result

Value of FD(0)	Meaning
0x0000	Accepted successfully
0xFFFF	Other error

FCC: 0x**

Figure 32 – Format of response command

c) Adapter start-up notification command and adapter start-up notification acceptance response command (Required)

If both the initialization sequence and object construction sequence have been successfully completed and the basic Network Adapter has at least a Device object or the process of constructing a Device object has been successfully completed, the basic Network Adapter shall send an adapter start-up notification to the Network-ready equipment. Before sending this adapter start-up notification, the profile object specified shall have been constructed. If the construction of a Device object fails, an adapter start-up notification containing start-up failed shall be sent and a shift shall be made to the Error Stop state. If an Adapter start-up notification response containing accepted successfully is received, a shift shall be made to the normal operation state. Upon reception of an adapter start-up notification, the Network-ready equipment shall return an adapter start-up notification acceptance response to the basic Network Adapter. If an adapter start-up notification containing start-up failed is received, the initialization sequence shall be redone. The direction of request commands is from Network Adapter to Network-ready equipment. Figure 33 shows the format of request command.

1 octet	2 octets	1 octet	1 octet	2 octets	2 octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FCC

STX: 0x02

FT: 0x0002

CN: 0x02

FN: 0x**

DL: 0x0002

FD(0): Initialization processing result

Value of FD(0)	Meaning
0x0000	Startup completed successfully
0x0011	Startup failed

FCC: 0x**

Figure 33 – Format of request command

Figure 34 shows the format of response command.

1 octet	2 octets	1 octet	1 octet	2 octets	2 octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FCC

STX: 0x02

FT: 0x0002

CN: 0x82

FN: Value at the time of the request (0x00 if the function is not implemented)

DL: 0x0002

FD(0): Response result

Value of FD(0)	Meaning
0x0000	Accepted successfully
0xFFFF	Other error

FCC: 0x**

Figure 34 – Format of response command

d) Equipment inquiry request/response command with object designation (optional)

When there is no Device object in the basic Network Adapter, the Adapter shall make an equipment inquiry request with object designation to the Network-ready equipment. The Network-ready equipment shall respond with the equipment information in the form of an equipment inquiry response with object designation which includes the information necessary to construct the Device objects in the basic Network Adapter. The Network Adapter shall acquire and manage the object information. The Network-ready equipment shall respond to the Network Adapter by adding to the AOJ code a 1-octet object identification number (that

begins with 0x01) with the total number of AOJs and shall manage it. The Network Adapter shall identify and manage the objects using the object identification numbers. This command shall be required for Network Adapters that are capable of generating 4 or more Device objects and Network-ready equipments that are capable of making a request for the generation of 4 or more Device objects. The direction of request commands is from the Network Adapter to the Network-ready equipment.

Figure 35 shows the format of request command.

STX: 0x02

FT: 0x0002

CN: 0x03

FN: 0x**

DL: 0x0001

FD(0):

Object identification number (used in increasing order beginning with 0x01)

FCC: 0x**

Figure 35 – Format of request command

Figure 36 shows the format of response command.

1 octet	2 octets	1 octet	1 octet	2 octets	2 octets	1 octet	n octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FD(1)	FD(2)	FCC

STX: 0x02

FT: 0x0002

CN: 0x83

FN:

The value at the time of the request (0x00 if the function is not implemented)

DL: 0x****

FD(0): Content of response (result)

Name	Size (in octets)	Explanation
Result	2	Content of response (result): 0x0000: Accepted 0x0001: Accepted (network not in operation) 0x0011: Rejected 0x0012: The specified equipment object does not exist. 0x0101: Status mismatch error (equipment interface confirmation state (unconfirmed)) 0x0103: Status mismatch error (standby state) 0x0105: Status mismatch error (error stop state) 0xFFFF: Other errors

FD(1): Number of objects sent in the frame.

Fixed at 0x01.

FD(2): Object data. Refer to the object data format. of Figure 37

FCC: 0x**

Figure 36 – Format of response command

Figure 37 shows the format of object data.

2 octets	3 octets	2 octets	194 to 289 octets
Object identification information	AOJ	Equipment inquiry data length	Equipment inquiry data

Name	Size (in octets)	Explanation
Object identification information	2	First octet: Object identification number Second octet: Total number of objects
AOJ	3	The AOJ code number for the equipment object to be constructed
Equipment inquiry data length	2	Indicates the size of the Equipment inquiry data.
Equipment inquiry data	194 to 289	Refer to the Equipment inquiry data format. see Figure 38

Figure 37 – Format of Object Data

Figure 38 shows the format of equipment inquiry data.

2 octets	17 octets	17 octets	17 octets	17 octets	17 octets	17 octets
Effective/ineffective bit map	SetM property map	Set property map	GetM property map	Get property map	Status change announcement property map	IASetup property operation map

17 octets	17 octets	17 octets	4 octets	3 octets	3 octets	12 octets
IAGetup property operation map	IASetMup property operation map	IAGetMup property operation map	Version information	Manufacturer code	Factory code	Product code

12 octets	4 octets	1 to 128 octets
Production number	Production date	Property size map

Name	Size (in octets)	Explanation
Effective/ineffective bit map	2	Indicates the meaningful part in the data that follows: b15: SetM property map b14: Set property map b13: GetM property map b12: Get property map b11: Status change announcement property map b10: IASetup property operation map b9: IAGetup property operation map b8: IASetMup property operation map b7: IAGetMup property operation map b6: Version information b5: Manufacturer code b4: Factory code b3: Product code b2: Production number b1: Date of production b0: Property size map The items set to 1 are effective.
SetM property map	17	Indicates the property that accepts SetM. See the format in Annex C.
Set property map	17	Indicates the property that accepts Set. See the format in Annex C.
GetM property map	17	Indicates the property that accepts GetM. See the format in Annex C.
Get property map	17	Indicates the property that accepts Get. See the format in Annex C.
Status change announcement property map	17	Indicates the property that performs status change announcements. See the format in Annex C.
IASetup property operation map	17	Indicates the internal service of the Network Adapter for the property that accepts Set. The Set for the property that was specified as an effective one shall become IASetup. The process of reflecting it in the AOJ is performed after the status alteration on the Network-ready equipment side. Then the response is returned. See the format in Annex C.
IAGetup property operation map	17	Indicates the internal service of the Network Adapter for the property that accepts Get. The Get for the property that was specified as an effective one shall become IAGetup. The process of reflecting it in the AOJ is performed after the status alteration on the Network-ready equipment side. Then the response is returned. See the format in Annex C.
IASetMup property operation map	17	Indicates the internal service of the Network Adapter for the property that accepts SetM. The SetM for the property that was specified as an effective one shall become IASetMup. The process of reflecting it in the AOJ is performed after the status alteration on the Network-ready equipment side. Then the response is returned. See the format in Annex C.
IAGetMup property operation map	17	Indicates the internal service of the Network Adapter for the property that accepts GetM. The GetM for the property that was specified as an effective one shall become IAGetMup. The process of reflecting it in the AOJ is performed after the status alteration on the Network-ready equipment side. Then the response is returned. See the format in Annex C.
Version information	4	Indicates the specification version used.
Manufacturer code	3	Indicates the code defined by each Home Network Standard Association/Consortium if required for the Network-ready equipment.
Factory code	3	Indicates the vendor-dependent code that indicates the factory that manufactured the Network-ready equipment.
Product code	12	Indicates the vendor-dependent Network-ready equipment product code.
Production number	12	Indicates the vendor-dependent Network-ready equipment production number.
Date of production	4	Indicates the date on which the Network-ready equipment was manufactured.
Property size map	1 to 128	Indicates the size of each property in octets. In the case of an array property, this shall be the product of the size of one array element and the maximum number of array elements. For the properties that are present, the sizes are listed starting from the one with the smallest APC.

Figure 38 – Format of equipment inquiry data

4.6.2.4.4 Home Network communication mode

a) Equipment status access request and response commands (required)

If a Set is performed for a property whose internal service is IASetup/IASetMup, or if a Get is performed for a property whose internal service is IAGetup/IAGetMup, the basic Network Adapter shall report the Set/SetM or Get/GetM information to the Network-ready equipment by means of an equipment status access request. Upon reception of the equipment status access request, the Network-ready equipment shall return to the basic Network Adapter a corresponding response (when it is IASetup/IASetMup) or the status value that corresponds to the specified property (when it is IAGetup/IAGetMup) (equipment status access response).The direction of request commands is from the Network Adapter to the Network-ready equipment. Figure 39 shows the format of the request commands.

1 octet	2 octets	1 octet	1 octet	2 octets	6+n octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FCC

STX: 0x02

FT: 0x0003

CN: 0x10

FN: 0x**

DL: 6+n

FD(0): Object information

Name	Size (in octets)	Explanation
AOJ	3	AOJ code for the Network-ready equipment (referenced or altered)
Length	2	The number of octets obtained by adding up the APC and ADT. The value 0x01 indicates IASetup (status reference) and the other values indicate IAGetup (status alteration).
APC	1	APC for the property (referenced or altered)
ADT	n	The presence of this value indicates an alteration/property. In that case, the status that indicates the APC (Network-ready equipment) is altered (maximum 245 octets). If this value is not present, it indicates referencing with respect to status.

FCC: 0x**

Figure 39 – Format of request command

Figure 40 shows the format of response command.

STX: 0x02

FT: 0x0003

CN: 0x90

FN: Value at the time of the request (0x00 if the function is not implemented)

DL: 8+n

FD(0): Object information

Name	Size (in octets)	Explanation
AOJ	3	AOJ code for the Network-ready equipment (referenced or altered)
Result	2	Response result 0x0000: Acceptance response 0x0011: Rejection response 0xFFFF: Other error
Length	2	The number of octets obtained by adding up the APC and ADT. The value 0x01 indicates an alteration response and the other values indicate a reference response.
APC	1	APC for the property (referenced or altered)
ADT	n	If this value is present, it becomes the reference response value (max. 245 octets).

FCC: 0x**

Figure 40 – Format of response command

b) Equipment status notification request and response commands (required)

Upon reception of an equipment status notification request, the basic Network Adapter shall return an equipment status notification response to the Network-ready equipment, and if the internal service of the Network Adapter for the property reported is IAGet/IAGetM, the value to be reported shall be written to the property for the Device object that it contains and the value shall be broadcast throughout the domain. If the internal service of the Network Adapter for the property reported is IAGetup/IAGetMup, the Network Adapter shall return an equipment status notification response to the Network-ready equipment and the value to be reported shall be broadcast throughout the domain.The direction of request commands is from the Network-ready equipment to the Network Adapter. Figure 41 shows the format of the request commands.

STX: 0x02

FT: 0x0003

CN: 0x11

FN: 0x** (0x00 if the function is not implemented)

DL: 6+n

FD(0): Object information

Name	Size (in octets)	Explanation
AOJ	3	AOJ code for the Network-ready equipment (referenced)
Length	2	The number of octets obtained by adding up the APC and ADT
APC	1	APC for the property (reported)
ADT	n	Reported data (max. 245 octets)

FCC: 0x**

Figure 41 – Format of request command

Figure 42 shows the format of response command.

1 octet	2 octets	1 octet	1 octet	2 octets	2 octets	3 octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FD(1)	FCC

STX: 0x02

FT: 0x0003

CN: 0x91

FN: Value at the time of the request

DL: 0x0005

FD: Processing result

Name	Size (in octets)	Explanation
Result	2	Response result 0x0000: Acceptance response 0x0011: Rejection response (network not operating) 0x0012: Rejection response (other) 0x0101: Status discrepancy error (equipment interface confirmation state (unconfirmed)) 0x0102: status discrepancy error (external equipment data confirmation (reference) state) 0x0103: status discrepancy error (standby state) 0x0104: status discrepancy error (object construction state) 0x0105: status discrepancy error (error stop state) 0xFFFF: other error

FD(1): AOJ code for the Network-ready equipment (reported)

FCC: 0x**

Figure 42 – Format of response command

c) Element designation equipment status access request and response commands (required)

If a SetM is performed for a property whose internal service is IASetMup, or if a GetM is performed for a property whose internal service is IAGetMup, the basic Network Adapter shall report the SetM or GetM information to the equipment by means of an element designation equipment status access request. Upon reception of the element designation equipment status access request, the Network-ready equipment shall return to the basic Network Adapter a response to that request (when it is IASetMup) or the status value that corresponds to the element number of the property specified (when it is IAGetMup) by means of element designation equipment status access response. The direction of request commands is from the Network Adapter to the Network-ready equipment. Figure 43 shows the format of the request commands.

1 octet	2 octets	1 octet	1 octet	2 octets	8+n octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FCC

STX: 0x02

FT: 0x0003

CN: 0x12

FN: 0x**

DL: 8+n

FD(0): Network Adapter type

Name	Size (in octets)	Explanation
AOJ	3	AOJ code for the Network-ready equipment (referenced or altered)
Length	2	The number of octets obtained by adding up the APC and ADT. The value 0x01 indicates referencing, and the other values indicate an alteration.
APC	1	APC for the property (referenced or altered)
Element number	2	Element number for the array (referenced or altered)
ADT	n	The presence of this value indicates an alteration/property. In that case, the status that indicates the APC (Network-ready equipment) is altered (maximum 245 octets). If this value is not present, it indicates referencing with respect to status.

FCC: 0x**

Figure 43 – Format of request command

Figure 44 shows the format of response command.

1 octet	2 octets	1 octet	1 octet	2 octets	10+n octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FCC

STX: 0x02

FT: 0x0003

CN: 0x92

FN: Value at the time of the request (0x00 if the function is not implemented)

DL: 10+n

FD(0): Object information

Name	Size (in octets)	Explanation
AOJ	3	AOJ code for the Network-ready equipment (referenced or altered)
Result	2	Response result 0x0000: Acceptance response 0x0011: Rejection response 0xFFFF: Other error (No AOJ, APC exist, etc.)
Length	2	The number of octets obtained by adding up the APC and ADT. The value 0x01 indicates an alteration response and the other values indicate a reference response.
APC	1	APC for the property (referenced or altered)
Element number	2	Element number for the array (referenced or altered)
ADT	n	If this value is present, it becomes the reference response value.

FCC: 0x**

Figure 44 – Format of response command

d) Element designation equipment status notification request and response commands (required)

Upon reception of an element designation equipment status notification, the basic Network Adapter shall return an element designation equipment status notification response to the Network-ready equipment, and if the internal service of the Network Adapter for the property reported is IAGetM, the value to be reported shall be written to the property (element number) for the Device object that it contains and the value shall be broadcast throughout the domain. If the internal service of the Network Adapter for the property reported is IAGetMup, the Network Adapter shall return an element designation equipment status notification response to the Network-ready equipment and the value specified by the element number of the property shall be broadcast throughout the domain. The direction of request commands is from the Network-ready equipment to the Network Adapter. Figure 45 shows the format of the request commands.

1 octet	2 octets	1 octet	1 octet	2 octets	8+n octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FCC

STX: 0x02

FT: 0x0003

CN: 0x13

FN: 0x** (0x00 if the function is not implemented)

DL: 8+n

FD(0): Object information

Name	Size (in octets)	Explanation
AOJ	3	AOJ code for the Network-ready equipment (reported)
Length	2	The number of octets obtained by adding up the APC and ADT.
APC	1	APC for the property (reported)
Element number	2	Element number (reported)
ADT	n	Reported data (maximum, 245 octets)

FCC: 0x**

Figure 45 – Format of request command

Figure 46 shows the format of response command.

1 octet	2 octets	1 octet	1 octet	2 octets	2 octets	3 octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FD(1)	FCC

STX: 0x02

FT: 0x0003

CN: 0x93

FN: Value at the time of the request

DL: 0x0005

FD(0): Response result

Name	Size (in octets)	Explanation
Result	2	Response result 0x0000: Acceptance response 0x0011: Rejection response (network not operating) 0x0012: Rejection response (other) 0x0101: Status discrepancy error (equipment interface confirmation state (unconfirmed)) 0x0102: Status discrepancy error (external equipment data confirmation (reference state)) 0x0103: Status discrepancy error (standby state) 0x0104: Status discrepancy error (object construction state) 0x0105: Status discrepancy error (error stop state) 0xFFFF: Other error

FD(1): AOJ code for the Network-ready equipment (reported)

FCC: 0x***

Figure 46 – Format of response command

e) Object access request and response commands (required)

If an Object access request is made for a property for which the internal service of the Network Adapter is IASet/IASetM, the basic Network Adapter shall write the specified property value into the property. If an object access request is made for a property for which the internal service of the Network Adapter is IAGet/IAGetM, the basic Network Adapter shall return the specified property value to the Network-ready equipment through an object access response. If an object access request is made for both IASetup and IAGetup, or both IASetMup and IAGetMup, an object access response with the rejection response result shall be returned to the Network-ready equipment. The direction of request commands is from the Network-ready equipment to the Network Adapter. Figure 47 shows the format of the request commands.

1 octet	2 octets	1 octet	1 octet	2 octets	6+n octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FCC

STX: 0x02

FT: 0x0003

CN: 0x14

FN: 0x** (0x00 if the function is not implemented)

DL: 6+n

FD(0): Object information

Name	Size (in octets)	Explanation
AOJ	3	AOJ code for the Network-ready equipment (referenced or altered)
Length	2	The number of octets obtained by adding up the APC and ADT. The value 0x01 indicates referencing, and the other values indicate an alteration.
APC	1	APC for the property (referenced or altered)
ADT	n	The presence of this value indicates an alteration/property. In that case, the status that indicates the APC (Network-ready equipment) is altered (maximum 245 octets). If this value is not present, it indicates referencing with respect to status.

FCC: 0x**

Figure 47 – Format of request command

Figure 48 shows the format of response command.

1 octet	2 octets	1 octet	1 octet	2 octets	2 octets	6+n octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FD(0)	FCC

STX: 0x02

FT: 0x0003

CN: 0x94

FN: Value at the time of the request

DL: 8+n

FD(0): Response result

Name	Size (in octets)	Explanation
Result	2	Response result 0x0000: Acceptance response 0x0001: Acceptance response (network not operating) 0x0011: Rejection response 0x0101: Status discrepancy error (equipment interface confirmation state (unconfirmed)) 0x0103: Status discrepancy error (standby state) 0x0104: Status discrepancy error (object construction state) 0x0105: Status discrepancy error (error stop state) 0xFFFF: Other error

FD(1): Object information

Name	Size (in octets)	Explanation
AOJ	3	AOJ code for the Network-ready equipment (referenced or altered)
Length	2	The number of octets obtained by adding up the APC and ADT. The value 0x01 indicates an alteration response, and the other values indicate a reference response.
APC	1	APC for the property (referenced or altered)
ADT	n	If this value is present, it becomes the reference response value (maximum 245 octets).

FCC: 0x**

Figure 48 – Format of response command

f) Equipment status access request/response (all) (optional)

The equipment status access request (all) and equipment status access response (all) commands shall be used when it is necessary to perform one of the operations listed below. The Network Adapter shall use these commands to read values from and write values into the Network-ready equipment for all of the properties for which the relevant service is specified.

- The reading of the property values held by the Network-ready equipment for all of the properties for which the IAGet or IAGetM service is specified.
- The reading of the property values held by the Network Adapter for all of the properties for which the IASet or IASetM service is specified.

- The notification of the property values held by the Network Adapter to the equipment for all of the properties for which the IAGet or IAGetM service is specified.
- The notification of the property values held by the Network Adapter to the equipment for all of the properties for which the IASet or IASetM service is specified.

When the Network-ready equipment receives an equipment status access request (all) command, it shall compose an appropriate response message for the relevant reading or notification request and shall send it back to the basic Network Adapter in the form of an equipment status access response (all) command.The direction of request commands is from Network Adapter to Network-ready equipment. Figure 49 shows the format of request command.

1 octet	2 octets	1 octet	1 octet	2 octets	2 octets	3 octets	n octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FD(1)	FD(2)	FCC

STX: 0x02

FT: 0x0003

CN: 0x20

FN: 0x00 to 0xFF

DL: FD(0) to FD(2) (HEX notation of the total size)

FD(0): Content of the access request

0x00: Property read request for the properties for which the IAGet or IAGetM service is specified

0x01: Property notification request for the properties for which the IAGet or IAGetM service is specified

0x02: Property read request for the properties for which the IASet or IASetM service is specified

0x03: Property notification request for the properties for which the IASet or IASetM service is specified

0x02 to 0xFF: Reserved for future use

FD(1): Object code (AOJ)

FD(2): Exists when FD(0) is 0x01 or 0x03.

When FD(0) is 0x01, the property values held by the Network Adapter as the values of the IAGet/IAGetM properties excluding the property map properties and the version information, manufacturer code, factory code, product code, production number and production date properties are listed beginning with the one with the smallest property code value and in increasing order.

When FD(0) is 0x03, the property values held by the Network Adapter as the values of the IASet/IASetM properties excluding the property map properties and the version information, manufacturer code, factory code, product code, production number and production date properties are listed beginning with the one with the smallest property code value and in increasing order.

FCC: 0x**

Figure 49 – Format of request command

Figure 50 shows the format of response command.

1 octet	2 octets	1 octet	1 octet	2 octets	2 octets	m octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FD(1)	FCC

STX: 0x02

FT: 0x0003

CN: 0xA0

FN:

The value at the time of the request (0x00 if the function is not implemented)

DL: FD(0) to FD(1) (HEX notation of the total size)

FD(0): Processing result

Value of FD(0)	Meaning	Remark
0x0000	Request accepted (Normal)	
0x0011	Request rejected (The specified object does not exist.)	
0xFFFF	Request rejected (for a reason other than the above)	
Other than the above	Reserved for future use	

FD(1):

Exists when the value of FD(0) in the request message is 0x00 or 0x02 (read request) and the value of FD(0) in the response message is 0x0000 (request accepted).

When FD(0) in the request message is 0x00, the property values held by the Network-ready equipment as the values of the IAGet/IAGetM properties excluding the property map properties and the version information, manufacturer code, factory code, product code, production number and production date properties are listed beginning with the one with the smallest property code value and in increasing order.

When FD(0) in the request message is 0x02, the property values held by the Network-ready equipment as the values of the IASet/IASetM properties excluding the property map properties and the version information, manufacturer code, factory code, product code, production number and production date properties are listed beginning with the one with the smallest property code value and in increasing order.

FCC: 0x**

Figure 50 – Format of response command

g) Equipment status access request/response (all, UP) (optional)

The equipment status access request (all, UP) and equipment status access response (all, UP) commands shall be used when the Network Adapter is capable of handling composite messages and it shall be necessary to perform one of the operations listed below. The Network Adapter shall use these commands to read values from and write values into the Network-ready equipment for all of the properties specified by a composite message.

- The reading, following a read request from another node for properties for which the IAGetup or IAGetMup service is specified, of the property values held by the Network-ready equipment for all of the relevant properties.
- The notification, following a write request from another node for properties for which the IASetup or IASetMup service is specified, of the requested values to the Network-ready equipment.

When the Network-ready equipment receives an equipment status access request (all, UP) command, it shall compose an appropriate response message for the relevant read or write

request and send it back to the basic Network Adapter in the form of an equipment status access response (all, UP) command.

If the Network Adapter receives, instead of a normal response to the request, a communication error command in which a command error is reported, the Network Adapter shall make requests individually for the properties specified in the composite message using the equipment status access request command. The direction of request commands is from Network Adapter to Network-ready equipment. Figure 51 shows the format of request command.

1 octet	2 octets	1 octet	1 octet	2 octets	2 octets	3 octets	2 octets	1-256 octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FD(1)	FD(2)	FD(3)	FCC

STX: 0x02

FT: 0x0003

CN: 0x21

FN: 0x00 to 0xFF

DL: FD(0) to FD(3) (HEX notation of the total size)

FD(0): Content of the access request

0x00: Property value read request for the properties for which the IAGetup or IAGetMup service is specified

0x01: Property value write request for the properties for which the IASetup or IASetMup service is specified

0x02 to 0xFF: Reserved for future use

FD(1): Object code (AOJ)

FD(2):

2 octets. Number of APC values, APC code + number of array elements

When the specified property is not an arrayed property:

The first octet is fixed at 0x00 and the second octet indicates the number of APC values.

When the specified property is an arrayed property:

The first octet indicates the APC code value (0x80 to 0xFF) and the second octet indicates the number of array elements.

FD(3):

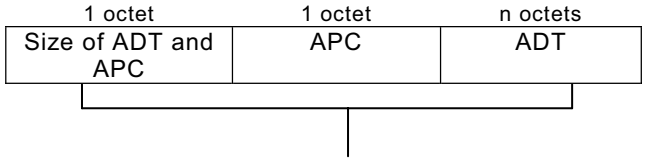
The composition of FD(3) for FD(0) = 0x00 is different from the composition of FD(3) for FD(0) = 0x01:

When the value of FD(0) is 0x00 and the first octet of FD(2) is 0x00, the APC code values for which an IAGetup request has been made are listed. The number of APC values to be listed is specified by the second octet of FD(2).

When the value of FD(0) is 0x00 and the first octet of FD(2) is other than 0x00 (i.e. the specified property is an arrayed property), the array element numbers for which an IAGetup request has been made are listed. The number of array elements to be listed is specified by the second octet of FD(2).

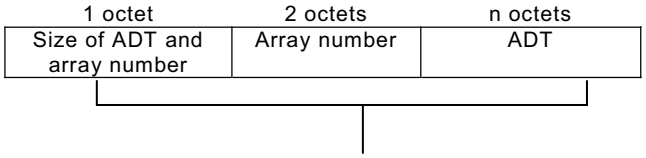
When the value of FD(0) is 0x01, either one of the following operations is performed depending on whether the specified property is an arrayed property or not:

When the value of FD(0) is 0x01 and the specified property is not an arrayed property, pieces of information in the following format are listed until the number of pieces of information reaches the number of APC values specified by FD(2).



Piece of information for one APC. The number of pieces of information to be listed is equal to the number of APC values specified by FD(2).

When the value of FD(0) is 0x01 and the specified property is an arrayed property, pieces of information in the following format are listed until the number of pieces of information reaches the number of array elements specified by FD(2).

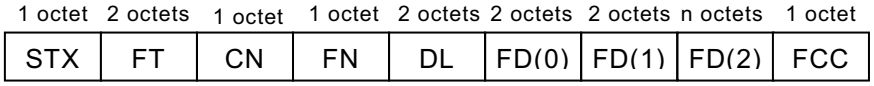


Piece of information for one array element. The number of pieces of information to be listed is equal to the number of array elements specified by FD(2).

FCC: 0x**

Figure 51 – Format of request command

Figure 52 shows the format of response command.



STX: 0x02

FT: 0x0003

CN: 0xA1

FN:

The value at the time of the request (0x00 if the function is not implemented)

DL: FD(0) to FD(2) (HEX notation of the total size)

FD(0): Processing result

Value of FD(0)	Meaning	Remark
0x0000	Request accepted (Normal)	
0x0011	Request rejected (The specified object does not exist)	
0xFFFF	Request rejected (for a reason other than the above)	
Other than the above	Reserved for future use	

FD(1):

Exists when the value of FD(0) in the response message is 0x0000 (request accepted). 2 octets.

When the specified property is not an arrayed property:

- The first octet is fixed at 0x00 and the second octet indicates the number of APC values.

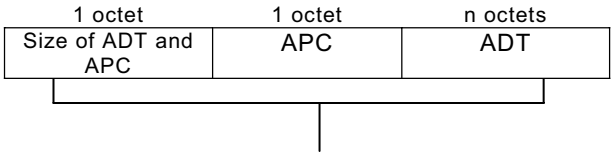
When the specified property is an arrayed property:

- The first octet indicates the APC code value (a value other than 0x00) and the second octet indicates the number of array elements of ADT.

FD(2):

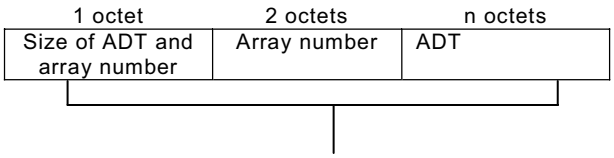
Exists when the value of FD(0) in the response message is 0x0000 (request accepted) and the value of FD(0) in the request message is 0x00.

When the specified property is not an arrayed property, pieces of information in the following format are listed until the number of pieces of information reaches the number of APC values specified by FD(1).



Piece of information for one APC. The number of pieces of information to be listed is equal to the number of APC values specified by FD(1).

When the specified property is an arrayed property, pieces of information in the following format are listed until the number of pieces of information reaches the number of array elements specified by FD(1).



Piece of information for one array element. The number of pieces of information to be listed is equal to the number of array elements specified by FD(1).

FCC: 0x**

Figure 52– Format of response command

h) Equipment status notification request/response (all) (optional)

The equipment status notification request (all) and equipment status notification response (all) commands shall be used when it is necessary to perform one of the operations listed below. The Network-ready equipment shall use these commands to notify the Network Adapter of the property values of all of the properties for which the relevant service is specified.

- The notification on the ADT of all of the properties for which the IAGet or IAGetM service is specified.
- The notification on the ADT of all of the properties for which the IASet or IASetM service is specified.
- The notification on the ADT of all of the properties for which the IAGetup or IAGetMup service is specified.
- The notification on the ADT of all of the properties for which the IASetup or IASetMup service is specified.

When the basic Network Adapter receives an equipment status notification request (all) command from the Network-ready equipment, the former shall return an Equipment status notification response (all) command to the latter and make an intra-domain announcement to notify other entities located in the domain of the properties for which notification should be made. If the Network Adapter is capable of handling composite messages, it will compose and send a composite message. When the Network Adapter receives the property value of a property for which IAGet, IAGetM, IASet or IASetM is specified, it shall replace the corresponding value it contains with the newly received value. The direction of request commands is from Network-ready equipment to Network Adapter. Figure 53 shows the format of request command.

1 octet	2 octets	1 octet	1 octet	2 octets	1 octet	3 octets	n octets	1 octet	m octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FD(1)	FD(2)	FD(3)	FD(4)	FCC

STX: 0x02

FT: 0x0003

CN: 0x22

FN: 0x** (0x00 if the function is not implemented)

DL: FD(0) to FD(4) (HEX notation of the total size)

FD(0): Content of the access request

0x00: Property notification request for the properties for which the IAGet or IAGetM service is specified

0x01: Property notification request for the properties for which the IASet or IASetM service is specified

0x02: Property notification request for the properties for which the IAGetup or IAGetMup service is specified

0x03: Property notification request for the properties for which the IASetup or IASetMup service is specified

0x04 to 0xFF: Reserved for future use

FD(1): Object code (AOJ)

FD(2):

The property values of the properties specified by FD(0) excluding the property map properties and the version information, manufacturer code, factory code, product code, production number and production date properties are listed, regardless of whether notification is to be made or not, beginning with the one with the smallest property code value and in increasing order.

FD(3):

The number of properties (out of the ones specified by FD(2)) whose values are to be notified to outside entities (i.e. the number of properties listed in FD(4))

FD(4):

The property code values to be notified to outside entities are listed.

FCC: 0x**

Figure 53 – Format of request command

Figure 54 shows the Format of Response Command.

1 octet	2 octets	1 octet	1 octet	2 octets	2 octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FCC

STX: 0x02

FT: 0x0003

CN: 0xA2

FN: The value at the time of the request

DL: 0x0002

FD(0): Content of response (result)

Name	Size (in octets)	Explanation
Result	2	Content of response (result): 0x0000: Accepted 0x0011: Rejected (network not in operation) 0x0012: Rejected (other) 0x0101: Status mismatch error (equipment interface confirmation state (unconfirmed)) 0x0103: Status mismatch error (standby state) 0x0104: Status mismatch error (object construction state) 0x0105: Status mismatch error (error stop state) 0xFFFF: An error other than the above

FCC: 0x**

Figure 54 – Format of response command

i) Object access request/response (all) (optional)

The object access request (all) and object access response (all) commands shall be used when it is necessary to perform one of the operations listed below. The Network-ready equipment shall use these commands to read values from and write values into the Network Adapter for all of the properties for which the relevant service is specified.

- The reading of the property values held by the Network Adapter for all of the properties for which the IASet or IASetM service is specified.
- The writing of property values by the Network-ready equipment into the Network Adapter for all of the properties for which the IAGet or IAGetM service is specified.

When the Network Adapter receives an object access request (all) command, it shall compose an appropriate response message for the relevant read or write request and send it back to the Network-ready equipment in the form of an object access response (all) command. The direction of request commands is from Network-ready equipment to Network Adapter. Figure 55 shows the format of request command.

1 octet	2 octets	1 octet	1 octet	2 octets	1 octet	3 octets	n octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FD(1)	FD(2)	FCC

STX: 0x02

FT: 0x0003

CN: 0x23

FN: 0x** (0x00 if the function is not implemented)

DL: FD(0) to FD(2) (HEX notation of the total size)

FD(0): Content of the access request

0x00: Property value read request for the properties for which the IASet or IASetM service is specified

0x01: Property value write request for the properties for which the IAGet or IAGetM service is specified

0x02 to 0xFF: Reserved for future use

FD(1): Object code (AOJ)

FD(2): Exists when the value of FD(0) is 0x01.

The property values held by the Network-ready equipment as the values of the IAGet/IAGetM properties excluding the property map properties and the version information, manufacturer code, factory code, product code, production number and production date properties are listed beginning with the one with the smallest property code value and in increasing order.

FCC: 0x**

Figure 55 – Format of request command

Figure 56 shows the format of response command.

1 octet	2 octets	1 octet	1 octet	2 octets	2 octets	n octets	1 octet	m octets	1 octet
STX	FT	CN	FN	DL	FD(0)	FD(1)	FD(2)	FD(3)	FCC

STX: 0x02

FT: 0x0003

CN: 0xA3

FN: The value at the time of the request

DL: FD(0) to FD(3), HEX notation of the total size

FD(0): Content of response (result)

Name	Size (in octets)	Explanation
Result	2	Content of response (result): 0x0000: Accepted 0x0001: Accepted (network not in operation) 0x0011: Rejected 0x0101: Status mismatch error (equipment interface confirmation state (unconfirmed)) 0x0103: Status mismatch error (standby state) 0x0104: Status mismatch error (object construction state) 0x0105: Status mismatch error (error stop state) 0xFFFF: An error other than the above

FD(1):

Exists when the value of FD(0) in the response message is 0x0000 or 0x0001 (i.e. accepted) and 0x00 is specified as the value of FD(0) in the request message.

The property values held by the Network-ready equipment as the values of the IASet/IASetM properties excluding the property map properties and the version information, manufacturer code, factory code, product code, production number and production date properties are listed beginning with the one with the smallest property code value and in increasing order.

FD(2):

Exists when FD(1) exists in the response message.

FD(2) indicates the number of properties (out of the ones specified by FD(1)) to be listed in FD(3).

FD(3):

Exists when FD(1) exists in the response message.

FD(3) lists the property code values of the properties (out of the ones specified by FD(1)) to which data was written from the outside after the last access request.

FCC: 0x**

Figure 56 – Format of response command

4.6.2.4.5 Communication error notification command (required)

If, during the process of receiving a frame, a communication error falling under any of the definitions given in the table below occurs on the Network Adapter or the Network-ready equipment, a communication error notification frame shall be sent as a response. The direction of the commands is from the Network Adapter to the Network-ready equipment, or vice versa. Figure 57 shows the format of the communication error notification command.

1 octet	2 octets	1 octet	1 octet	2 octets	1 octet
STX	FT	CN	FN	DL	FCC

STX: 0x02

FT: 0x00FF

CN: Error number

Error name	Command number	Description of error
FCC error	0x00	The frame was received successfully but the FCC is abnormal.
Command error	0x01	There is no corresponding command number.
Result error	0x02	The result of the received response frame is an undefined value.
Intra-frame error	0x03	The frame was received successfully, but the format is abnormal.
Other error	0xFF	Frame reception errors other than the above

FN: 0x**

DL: 0x0000

FCC: 0X**

Figure 57 – Communication error notification command

4.6.2.5 Communication sequences

This subclause describes the communication sequences for object generation type methods used for Network Adapter communication interface. The sequences are shown in Table 10. A detailed sequence-by-sequence explanation is given below.

Table 10 – Communication sequences (object generation type)

No.	Mode name	Sequence Name	Description
1	Equipment interface data confirmation	Equipment interface data confirmation sequence	Sequence allowing the Network Adapter to confirm the interface method and AOJs with the Network-ready equipment
2	Initialization	Initialization sequence	Sequence allowing the Network-ready equipment to perform an initialization for the Network Adapter
3	Object Construction	Object Construction sequence	Sequence allowing the Network Adapter to acquire AOJ information from the Network-ready equipment and generate internal objects
4	Home Network communication	Equipment status access request sequence	Sequence allowing the Network Adapter to report a Set/Get request (where there is a property in the Network-ready equipment)
5		Equipment status notification request sequence	Sequence allowing the Network-ready equipment to write values and send notifications to the outside (where there is a property in the Network Adapter)
6		Element designation equipment status access request sequence	Sequence allowing the Network Adapter to report a Set/Get request (where there is a property in the Network-ready equipment) (element designation)
7		Element designation equipment status notification request sequence	Sequence allowing the Network-ready equipment to write values and send notifications to the outside (where there is a property in the Network Adapter) (element designation)
8		Object access request sequence	Sequence allowing the Network-ready equipment to access properties held by the Network Adapter

4.6.2.5.1 Equipment interface data confirmation mode

a) Equipment interface data confirmation sequences (required)

The equipment interface data confirmation sequence is shown in Figure 58.

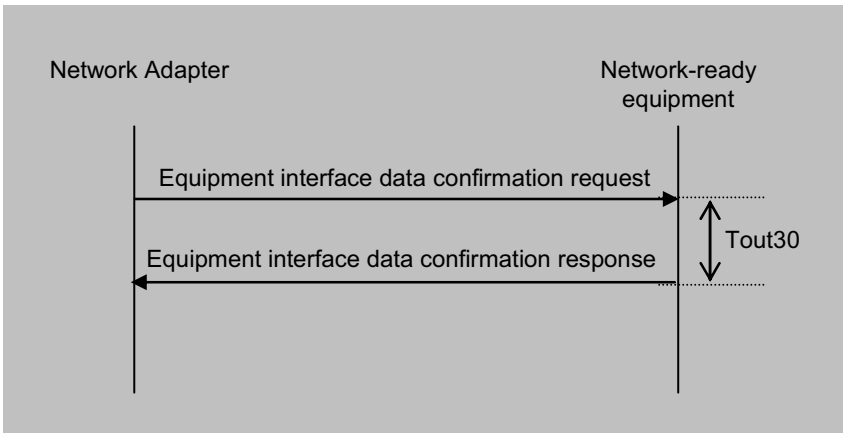


Figure 58 – Equipment interface data confirmation sequence

- Equipment Interface data confirmation sequence for the Network-ready equipment side

  The Network-ready equipment shall not accept frames other than the equipment interface data confirmation request while it is in the equipment interface data confirmation state. Upon reception of an equipment interface data confirmation request, the Network-ready equipment shall confirm the Network Adapter type and AOJs and shall return an equipment interface data confirmation response within the Tout30 period. In the case of an adapter type mismatch or AOJ data mismatch, an error shall be returned in the result field.

  In the case of an adapter type mismatch, the Network-ready equipment shall output a reset signal to the Network Adapter after the elapse of the Tout40 period and shall wait for an equipment interface data confirmation request. If the error state persists after repeating the attempt three times, the Network-ready equipment shall set the result field to equipment interface data disposal and shall return an equipment interface data confirmation response. After the elapse of the Tout50 period, the Network-ready equipment shall discard the equipment interface data and shall output a reset signal and make a shift to the unrecognized state.

  If, with all communication errors (such as frame errors) ignored by the Network-ready equipment, no equipment interface data confirmation request is received during the Tout50 period as measured from the transmission of a reset signal to the Network Adapter or from a power-on reset, the Network-ready equipment shall output a reset signal to the Network Adapter and wait for an equipment interface data confirmation request. If the error state persists after repeating the attempt three times, the Network-ready equipment shall discard the equipment interface data, shall output a reset signal to the Network Adapter and make a shift to the unrecognized state.

  The operation on the Network-ready equipment side during the unrecognized state shall be as per the equipment interface data recognition service specifications.

- Equipment interface data confirmation sequence for the Network Adapter Side

  After power-on, the basic Network Adapter shall send an equipment interface data confirmation request to the Network-ready equipment to confirm the AOJs and the communication method for the equipment adapter interface has been maintained. If no AOJ exists, an inquiry shall be made using 0 for the number of AOJs.

  Based on the result of the equipment interface data confirmation response, the following processing shall be performed:

  - If the result is normal completion, a shift is made to the standby state.
  - If the result is adapter type mismatch, a shift is made to the standby state.
  - If the result is object mismatch, a shift is made to the standby state after discarding the Device object data.
  - If the result is equipment interface data disposal, the Device object and equipment interface data are discarded and a shift is made to the unrecognized state within the Tout50 period.

  If, with all communication errors (such as frame errors) ignored by the Network Adapter, no response is received during the Tout61 period, an equipment interface data confirmation request shall be sent again. If no response is received after the request, the Device object and equipment interface data shall be discarded and a shift shall be made to the unrecognized state.

4.6.2.5.2 Initialization mode

a) Initialization sequence (required)

Initialization sequence is shown in Figure 59.

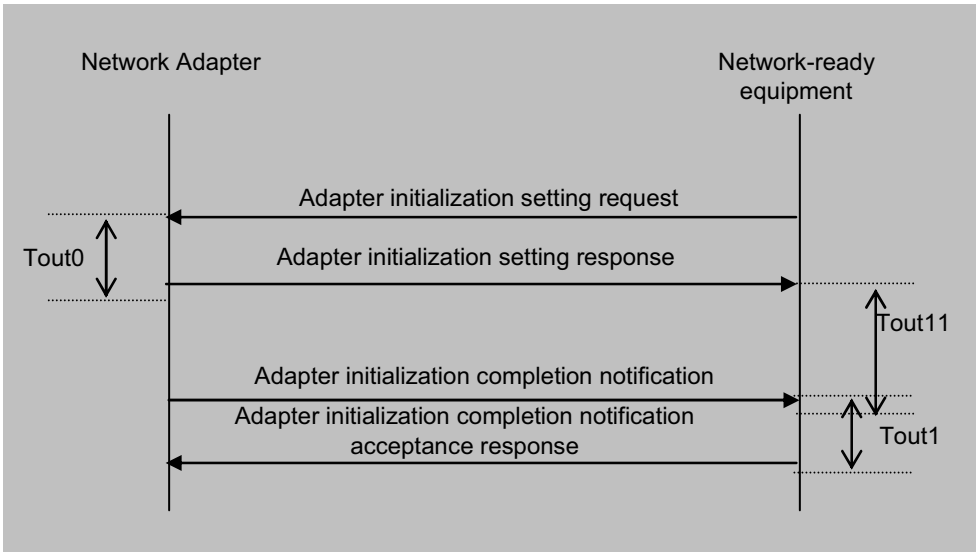


Figure 59 – Initialization sequence

- Initialization sequence for the Network-ready equipment side

  After a shift to the object Construction state, the Network-ready equipment shall send to the basic Network Adapter an Adapter initialization setting request for an initialization that uses an equipment data retention cold start (1) or (2).

  If no Adapter initialization setting response comes in during the Tout0 period, the request shall be re-sent, but only once. If no Adapter initialization setting response comes in after this retransmission, the Network-ready equipment shall start operating in the stand-alone mode.

  After receiving an Adapter initialization setting response, the Network-ready equipment shall wait for an initialization completion notification at least for the Tout11 period. If no Adapter initialization completion notification is received during this period, the Network-ready equipment shall terminate the initialization sequence and start operating in the stand-alone mode.

  If an Adapter initialization completion notification is received, the Network-ready equipment shall return to the basic Network Adapter an Adapter initialization completion notification acceptance response within the Tout1 period and wait for an Adapter start-up notification (when the Network Adapter already has a Device object) or an equipment inquiry request (when it is necessary to construct a Device object or Device objects).

- Initialization Sequence for the Network Adapter Side

  After receiving an Adapter initialization setting request that uses an equipment data retention cold start, the basic Network Adapter shall send back an Adapter initialization setting response within the Tout0 period and start an initialization of the inside of the Network Adapter.

  If the basic Network Adapter receives an Adapter initialization setting request for an initialization that uses an equipment data disposal cold start, the Network Adapter shall discard the Device object data and perform the same processing.

  After completion of the initialization, the basic Network Adapter shall send an Adapter initialization completion notification to the Network-ready equipment. If no Adapter initialization completion notification acceptance response comes in within the Tout1 period, the Adapter initialization completion notification shall be re-sent, but only once. If no response comes in after this retransmission, the basic Network Adapter shall stop the processing and start waiting for a request for an Adapter initialization setting request.

4.6.2.5.3 Object construction mode

a) Object construction sequence (required)

Figure 60 shows the sequence for this case when there is a Device object.

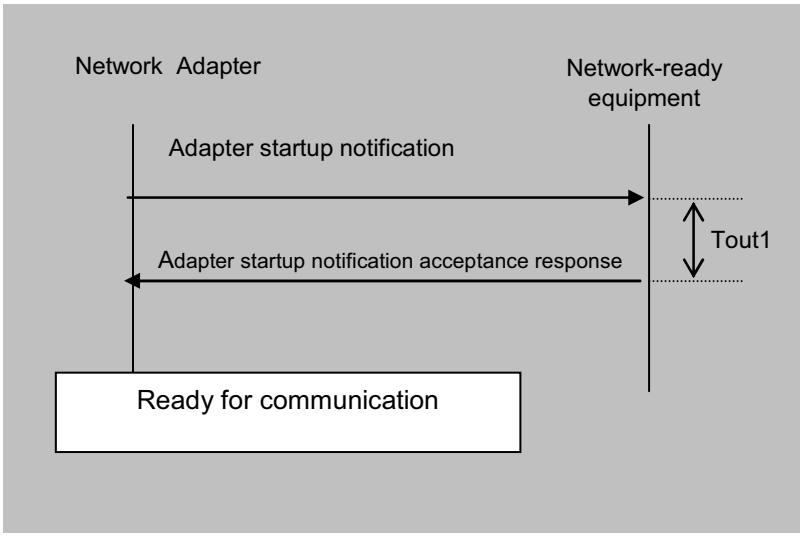


Figure 60 – Object construction sequence (1)

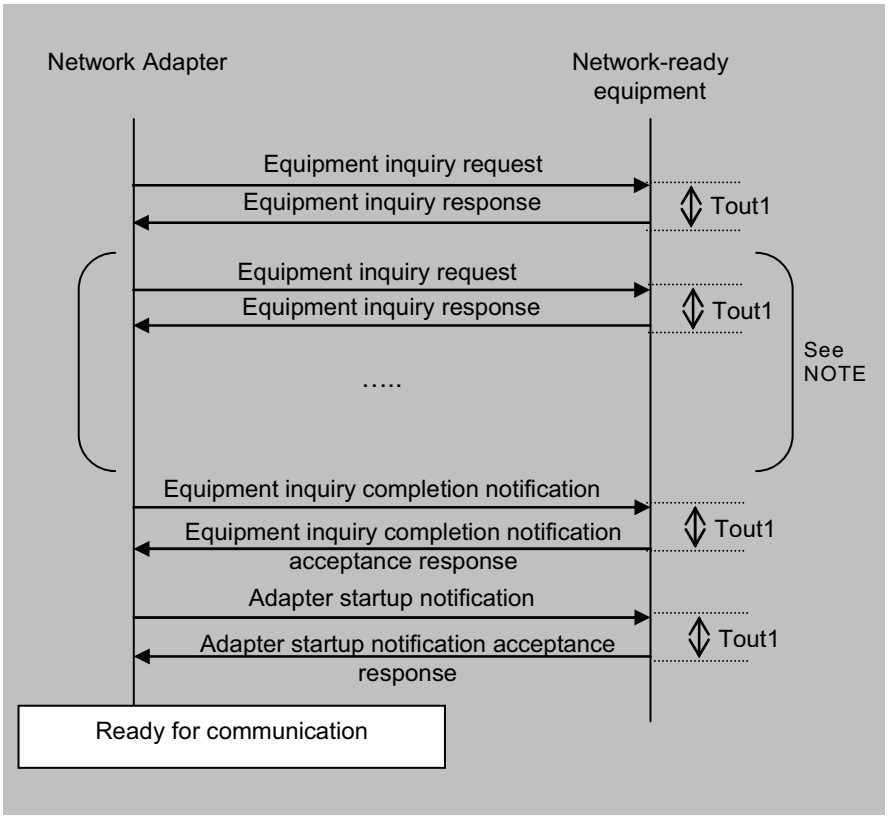
- Object construction sequence for the Network Adapter side

  After sending an Adapter start-up notification to the Network-ready equipment, the Network Adapter shall confirm that the Adapter start-up notification acceptance response is received from the Network-ready equipment within the Tout1 period, then shall shift to the Ready for communication state.

- Object Construction Sequence for the Network-ready equipment Side

  After receiving the Adapter start-up notification, the Network-ready equipment shall send the Adapter start-up notification acceptance response within the Tout1 period.

Figure 61 shows the sequence for this case when there is no Device object.



NOTE The number of equipment enquiries varies depending on the number of equipment objects.

Figure 61 – Object construction sequence (2)

- Object construction sequence for the Network Adapter side

  The Network Adapter first shall send an equipment inquiry request (or an equipment inquiry request with object designation) to the Network-ready equipment and then shall confirm that an equipment inquiry response (or an equipment inquiry response with object designation) is received from the Network-ready equipment within the Tout1 period. When there are two or more objects, the processing shall be repeated until the acquisition of the necessary object information is completed. After acquisition of the necessary object information, the Network Adapter shall send an equipment inquiry completion notification to the Network-ready equipment and confirm that an equipment inquiry completion notification acceptance response is received from the Network-ready equipment within the Tout1 period. After transmission of an Adapter start-up notification to the Network-ready equipment, the Network Adapter shall confirm that an Adapter start-up notification acceptance response is received from the Network-ready equipment within the Tout1 period. After this, the Network Adapter shall change its state to the normal operation state.

- Object Construction sequence for the Network-ready equipment side

  When the Network-ready equipment receives an equipment inquiry request (or an Equipment inquiry request with object designation), it shall send an equipment inquiry response (or an Equipment inquiry response with object designation) within the Tout1 period. If there are two or more pieces of object information, the processing shall be repeated. When the Network-ready equipment receives an equipment inquiry completion notification, it shall send an equipment inquiry completion notification acceptance response within the Tout1 period. When the Network-ready equipment receives an Adapter start-up notification, it shall send an Adapter start-up notification acceptance response within the Tout1 period.

4.6.2.5.4 Home Network communication mode

Five sequences for the Home Network communication mode are defined below.

a) Equipment status access request sequence (required)

The Network-ready equipment shall send an equipment status access response (equipment status access response (all)) within the Tout1 period after receiving an equipment status access request (equipment status access request (all)) from the Network Adapter. Figure 62 shows this sequence.

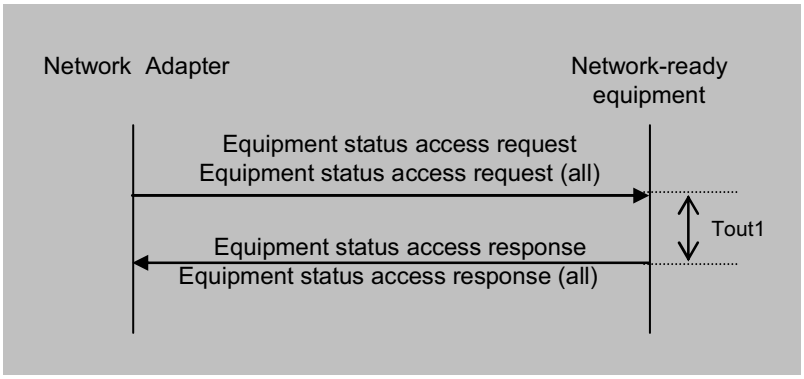


Figure 62 – Equipment status access request sequence

b) Network-ready equipment status notification request sequence (required)

The Network Adapter shall send an equipment status notification response (equipment status notification response (all)) within the Tout1 period after receiving an Equipment status notification request (equipment status notification request (all)) from the Network-ready equipment. Figure 63 shows this sequence.

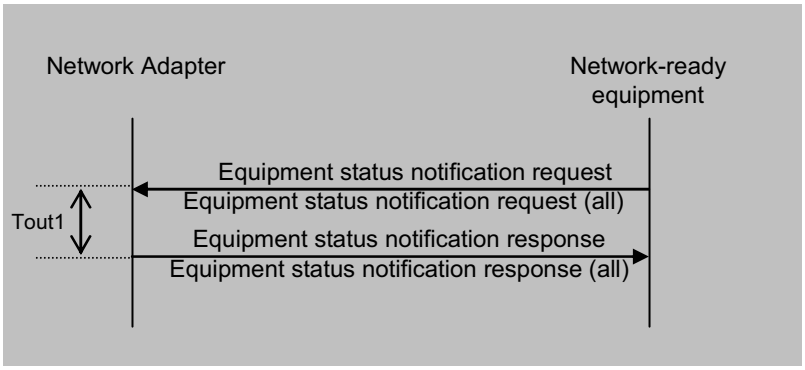


Figure 63 – Equipment status notification request sequence

c) Element designation equipment status access request sequence (required)

The Network-ready equipment shall send an element designation equipment status access response within the Tout1 period after receiving an element designation equipment status access request from the Network Adapter. Figure 64 shows this sequence.

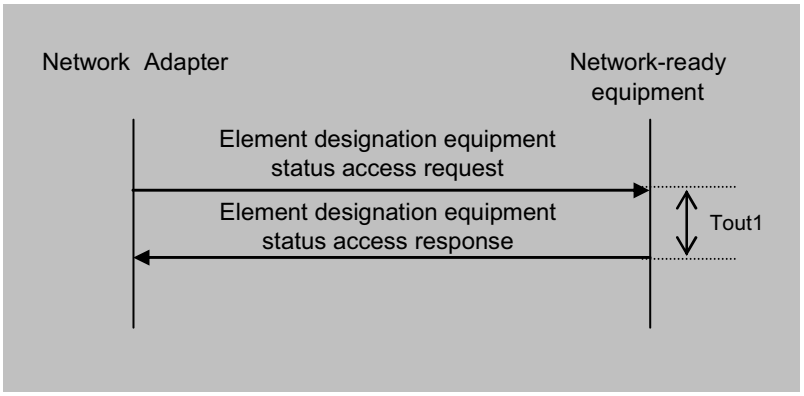


Figure 64 – Element designation equipment status access request sequence

d) Element designation equipment status notification request sequence (required)

The Network Adapter shall send an element designation equipment status notification response within the Tout1 period after receiving an element designation equipment status notification request from the Network-ready equipment. Figure 65 shows this sequence.

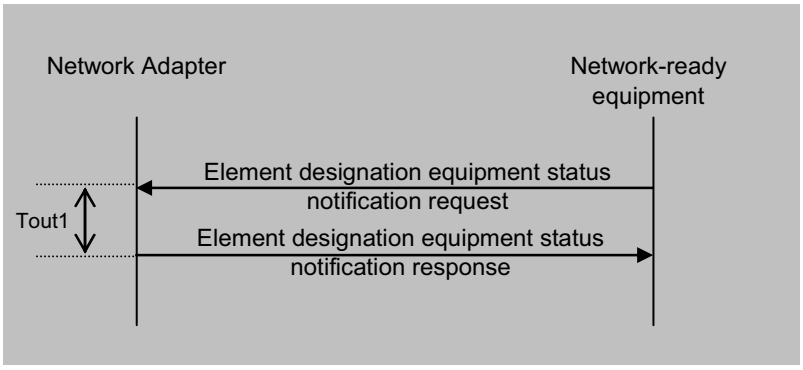


Figure 65 – Element designation equipment status notification request sequence

e) Object access request sequence (required)

The Network Adapter shall send an object access response (object access response (all)) within the Tout1 period after receiving an object access request (object access request (all)) from the Network-ready equipment. Figure 66 shows this sequence.

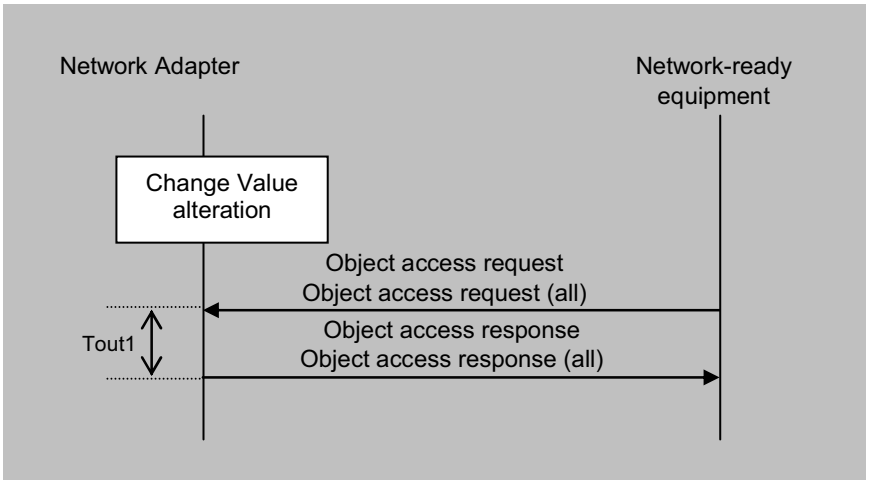


Figure 66 – Object access request sequence

4.6.2.5.5 Communication error processing sequence

a) for the Network-ready equipment side

If a communication error occurs while receiving a frame from the Network Adapter, the Network-ready equipment shall discard that frame and send a communication error notification frame. If the Network-ready equipment receives a communication error frame from the Network Adapter as a response to a command that the Network-ready equipment sent, the Network-ready equipment shall decide that the command was not successfully communicated and shall resend the command, as in the case of a timeout. It is recommended that a means be provided to indicate errors when communication errors occur frequently.

b) for the Network Adapter side

If a communication error occurs while receiving a frame from the Network-ready equipment, the Network Adapter shall discard that frame and send a communication error notification frame. If the Network Adapter receives a communication error frame from the Network-ready equipment as a response to a command that the Network Adapter sent, the Network Adapter shall decide that the command was not successfully communicated and resend the command, as in the case of a timeout. When communication errors occur frequently, the Network Adapter shall set the error property to the corresponding error code value, set the error status property to the value that corresponds to the error occurrence, and perform the communication error processing specified in 4.6.1.5.

4.6.2.5.6 Order of processing frames

In the case of a basic Network Adapter, the Network Adapter and Network-ready equipment shall not send a second request or notification frame until they receive a response frame for the first request or notification frame. Any new request or notification frame received before sending back a response frame shall be discarded.

4.6.2.5.7 Processing of composite messages

When a basic Network Adapter with a composite message processing function receives a Get request in the form of a composite message from another node, the basic Network Adapter shall perform the following processing:

- If the properties specified in the composite message do not include a property for which the IAGetup service is specified, the basic Network Adapter composes a response message and returns a response to the node in question.
- If the properties specified in the composite message include a property for which the IAGetup service is specified, the basic Network Adapter composes a response message and returns a response to the node in question after acquiring the necessary values from the equipment using an equipment status access request command or an equipment status access request (all, UP) command.

When a basic Network Adapter with a composite message processing function receives a Set request in the form of a composite message from another node, the basic Network Adapter will perform the following processing:

- If the properties specified in the composite message do not include a property for which the IASetup service is specified, the basic Network Adapter composes a response message and returns a response to the node in question.
- If the properties specified in the composite message include a property for which the IASetup service is specified, the basic Network Adapter composes a response message and returns a response to the node in question after notifying the Set request using an equipment status access request command or an equipment status access request (all, UP) command.

4.6.2.5.8 Timeout

The timeout values shall be in accordance with Table 11.

Table 11 – Timeout values

Symbol	Name	Time-out value	Explanation
Tout0, Tout1	Maximum response time 1	3 s	The maximum time the Network Adapter or Network-ready equipment can take to send back a response after receiving a request from the Network-ready equipment or Network Adapter, respectively
Tout10	Maximum initialization processing time	5 s	The maximum time that can be spent to perform initialization processing
Tout11	Maximum initialization processing waiting time	6 s	The maximum time that can be spent waiting for the completion of initialization processing
Tout2	Maximum response time 2	5 s	The maximum time a node can take to send back a response after receiving a request from another node
Tout30	Maximum equipment interface data confirmation processing waiting time (Network-ready equipment)	3 s	The maximum time the Network-ready equipment can take to send back an equipment interface data confirmation response to the Network Adapter
Tout40	Minimum object data disposal waiting time	6 s	The maximum time the Network-ready equipment can wait for the Network Adapter to discard the equipment interface data
Tout50	Maximum equipment interface data confirmation request issuance time	3 s	The maximum time that can elapse before the Network-ready equipment sends back an equipment interface data confirmation response to the Network Adapter
Tout61	Maximum equipment interface data confirmation processing waiting time (Network Adapter)	5 s	The maximum time the Network Adapter can wait for an equipment interface data confirmation response
NOTE Tout61 > Tout30, Tout61 > Tout50.			

4.6.2.6 Electrical characteristics

The electrical characteristics required for communication interface shall follow 4.4 with the exception of the following:

- RST (reset)

  This function is required for both Network-ready equipment and Network Adapter.
- Transmission speeds:

  One of the following speeds is required for Network-ready equipment.

  All of the following speeds are required for Network Adapter.

  :2 400 bps, 9 600 bps, 19 200 bps, 28 800 bps, 38 400 bps, 57 600 bps, 115 200 bps.

4.6.3 Communication software protocol for peer-to-peer type

Peer-to-peer type protocols allow a Network Adapter and a piece of Network-ready equipment to exchange data using a user-defined communication method. This standard does not define requirements for such protocols.

Annex A
(informative)

Application object

A.1 General

The objects specified in this standard were introduced with two objectives: first, to enable the compartmentalization of control content exchanged in communications, centering on devices connected to the Home Network; and second, to enable application software developers, whenever possible, to utilize this content without regard for communications (specifically, frame format and other detailed communications protocols). Objects are processed in the communications processing block. Control content exchanged in communications can be classified into four types: (1) those relating to functions unique to each device, (2) those relating to data profiling something other than the functions unique to each device, (3) those relating to object communication operations, and (4) those relating to service middleware functions. All of these are specified as objects, and control and data exchange were achieved to enable their manipulation. There are two main types of AOJs:

- Device objects
- Profile objects

Normally, AOJs have a number of properties. The various, unique functions possessed by AOJs are specified as application properties. Devices in other nodes are operated by reading the application properties of the AOJ in the relevant node and setting or controlling them accordingly. It was assumed that each node will have more than one Device object of the same type (e.g., body detection sensor AOJ). Identification can be performed by stipulating a specific code in the form of Device objects. Device operation functions of objects facilitate status confirmation and control between devices via communications. Device object data resides in the communications middleware, but the operation functions themselves reside in the application software block. The communications middleware manages instance property data and manages and processes operations related to property communications. Table A.1 shows an example of a properly formatted AOJ. Each property has APC, ADT, access rule, etc. Both non-array and array types are defined in ADT. The array type is a group of element data. Element data are pointed to by the element number. Data type and the size and content of ADT are defined for each property.

Table A.1 – Format of the AOJ

Property Name	APC	ADT (property content) Value range (decimal)	Data type	Data size	Access rule	Re-quired	Announce status change	Re-marks
Operating status	0x80	Shows ON/OFF status ON = 0x30, OFF = 0x31	Unsigned char	1 Byte	Set Get	 ○	○	
.....								

a) Device objects

Device objects are for the device operation functions of AOJs to facilitate status confirmation and control between devices via communications. Device object data resides in the communications middleware, but the operation functions themselves reside in the application software block. The communications middleware manages instance ADT and manages and processes operations related to property communications. Device objects is used to refer to

all objects, such as air conditioner objects and refrigerator objects, with the object definitions for such objects to be specified separately and individually as classes.

In a single appliance node, more than one Device object may be defined. Each Device object defines both properties to be used in each class and services corresponding to the content and properties. Figure A.1, below, demonstrates this relationship using a concrete example.

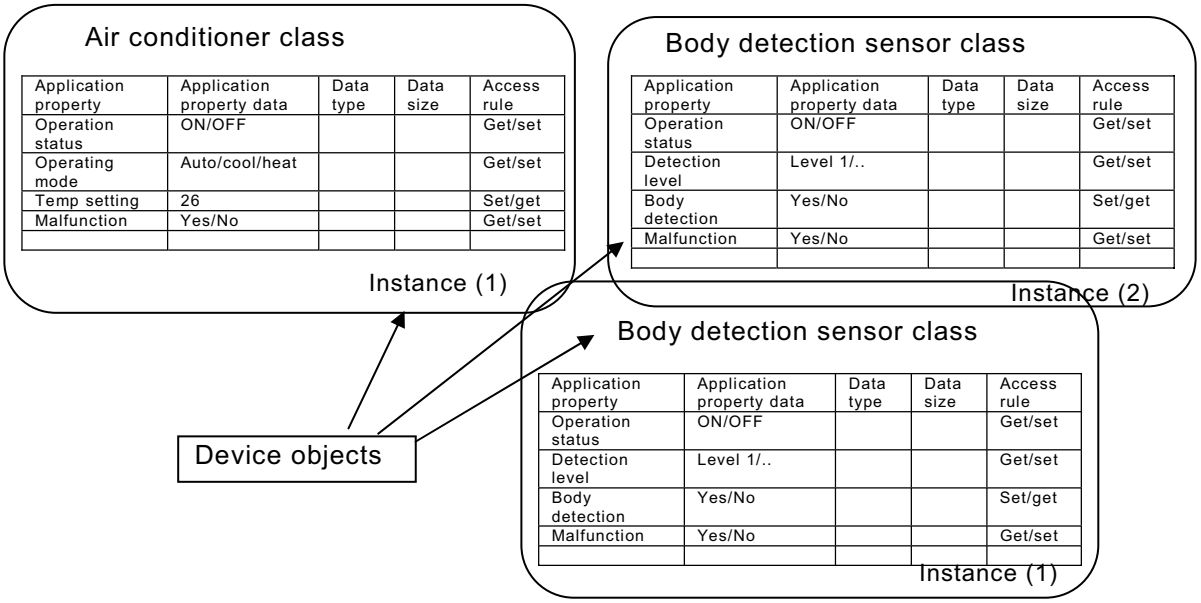


Figure A.1 – Device object configuration example

b) Profile objects

Node profile data are specified to enable manipulation (read/write) by application software and other nodes. In these specifications, the term profile objects will be used as a blanket term to refer to various profile classes, such as Node profile objects, router profile objects, and protocol difference absorption processing section profile objects, with detailed specifications to be provided individually. Like the Device objects, profile objects define application properties to be used in each class and services corresponding to the content and properties thereof. Operations on the various profiles of a node are performed by manipulating (reading/writing) these profile objects. It is possible to set, control, and confirm the status of the node profiles by manipulating (i.e., by reading/writing) these profile objects.

A.2 AOJ code

Each AOJ shall be represented by X1, X2, and X3. X1 is a group code which groups class codes, X2 is a class code which represents actual class names. X3 is the instance code which represents complex objects having the same group and class codes (X1, X2). X1, X2, and X3 are 1 octet respectively. Table A.2 gives examples for X1 and X2.

Table A.2 – List of class codes by group code

class group CODE (X1)	GROUP NAME	CLASS CODE (X2)	
0x00	Sensor-related device class group	0x00	Reserved for future use
		0x01	Gas leak sensor
			……
		0x07	Body detection sensor
			……
0x01	Air conditioner-related device class group	0x30	Air conditioner
		0x31	Cold air blower
		0x32	Fan
			……..
0x02	Housing/facility-related device class group	0x60	Electrically operated blinds
		0x61	Electrically operated shutter
		0x62	Electrically operated curtain
			……..
0x03	Cooking/housework-related device class group		
0x04	Health-related device class group		
0x05	Management/control-related device class group		
0x06–0x0C	Reserved for future use		
0x0D	Service class group		
0x0E	Profile class group		
0x0F	User definition class group		
0x10–0x1F	Communications definition class group for stipulation of status notification method		
0x20–0x2F	Communications definition class group for stipulation of setting control reception method		
0x30–0x3F	Communications definition class group for linked settings (action settings)		
0x40–0x4F	Communications definition class group for linked settings (trigger settings)		
0x50–0x7F	Reserved for future use		

A.3 APC

APC (Application Property Code) is assigned for each application property and is defined in Table A.3. APC is 1 octet and the assigned codes are for region shared by all application object classes, Region shared by each class group, region unique to each class, and user defined.

Table A.3 – APC allocation table

b3–b0 values (hex) ↑ \ ←b7–b4 values (hex)	8	9	A	B	C	D	E	F
0								
1								
2								
3								
4								
5								
6								
7	Region shared by all object classes		Region shared by each class group[2]		Region unique to each class[2]			User-defined[1]
8								
9								
A								
B								
C								
D								
E								
F								

NOTE 1 Stipulated for each user. In the case of a user-defined object class, 0xA to 0xF in the four high-order bits (b7 to b4) are user-defined.

NOTE 2 In principle, these two regions are used, but in practice the boundary line will change for each class group.

Annex B
(informative)

Access to the application object in the Node

Application software can access one or multiple remote nodes by using the services of the application layer. Control from application software using APIs is described for the three main cases listed below, with a focus on how the AOJs are perceived.

Case 1: Obtain other node status

Case 2: Control other node functions

Case 3: Notify other nodes of self-node status

a) AOJs when obtaining other node status

ISO/IEC 14543-4-1 provides two methods for obtaining the status of another node. These methods are shown in Figure B.1 and Figure B.2. In the method shown in Figure B.1, when a request is received from an application, an obtain status request (Get/GetM, etc.) is issued to objects in the specified other node (Node B), with the results notified to the application. With this method, object data for the other node need not be stored in the Communication Middleware for the node (Node A in the figure) making the request. In the second method, shown in Figure B.2, even when no request is received from an application, the Communication Middleware catches and holds the notified status of objects in other nodes in advance, and then returns them to an application when it receives a request.

In this method, objects copied to AOJs in other nodes actually exist within the communication middleware. In the former method, because the access is performed from an application, a virtual copy of the AOJs in the other node exists in the communication middleware. In both cases, in order to set the desired AOJ instance via the API, not only the AOJ class code but also an instance code and data specifying the node (data link address, etc.) are necessary. From the viewpoint of the application, therefore, AOJs are seen in the relationship shown in Figure B.3 within the communication middleware.

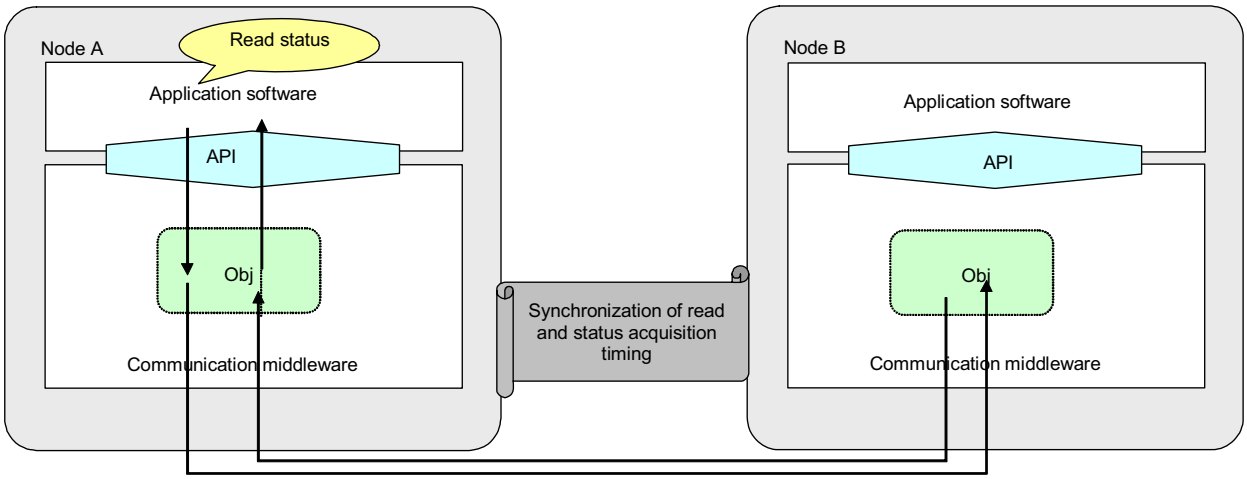


Figure B.1 – Service primitive (obtain other node status: synchronous type)

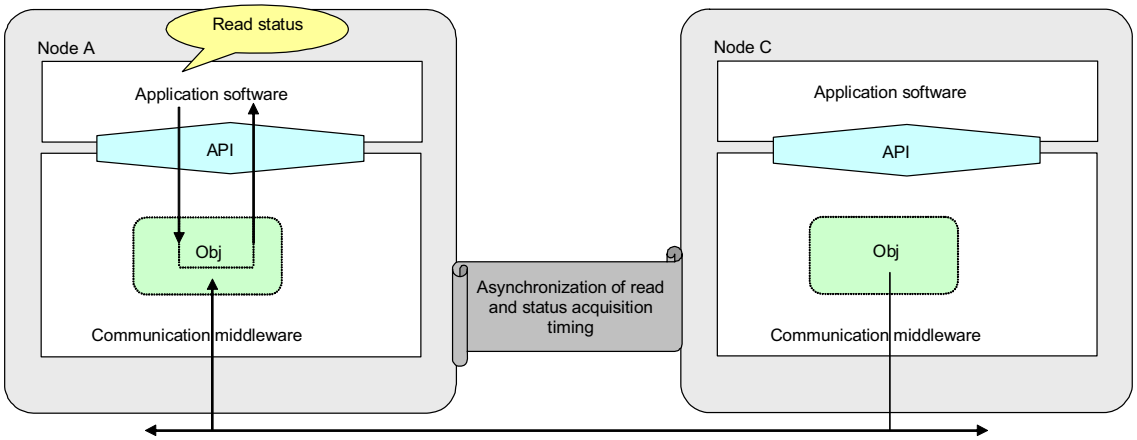


Figure B.2 – Service primitive (obtain other node status: asynchronous type)

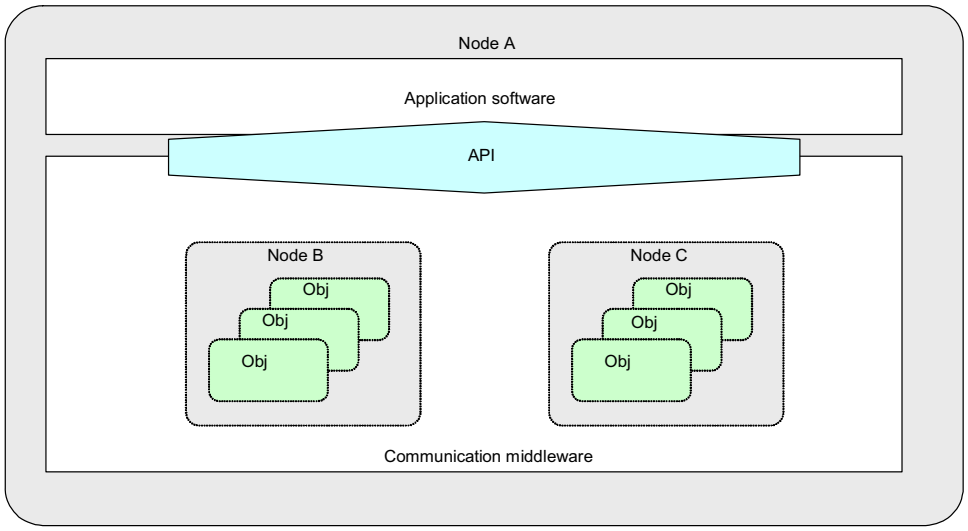


Figure B.3 – Example of object view

b) AOJs when controlling other node functions

ISO/IEC 14543-4-1 provides a method for controlling the functions of other nodes, as shown in Figure B.4. Just as in Figure B.1, however, a request for control (Set/SetM, property value setting) is issued to objects in the specified other node (Node B), and the application is then notified of the results (although there are exceptions to this). Basically, therefore, property data for objects in the other node (Node B) need not be present in the Communication Middleware for the node (Node A) making the request. To indicate the desired AOJ instance via the API, a Data Link Address, an AOJ class code, and its instance code are required. From the viewpoint of the application, AOJs are seen in the relationship shown by Node B in Figure B.5 within the Communication Middleware.

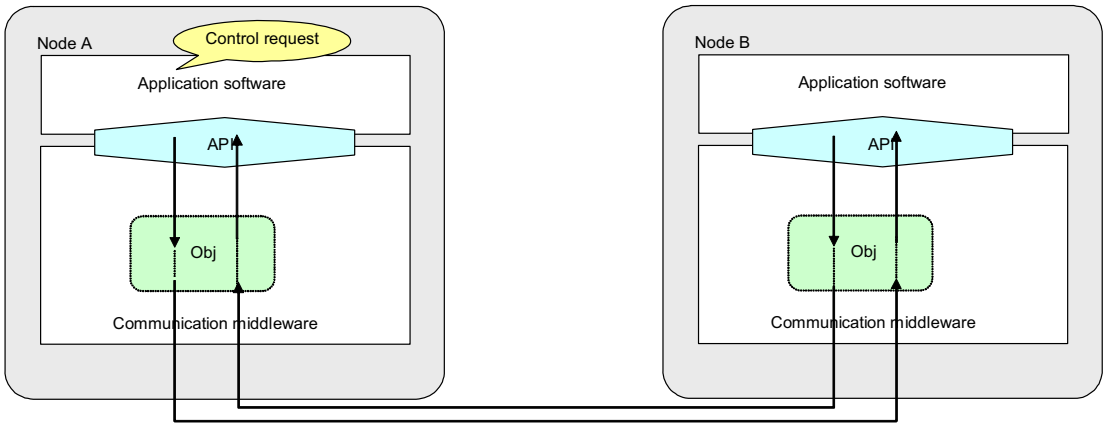


Figure B.4 – Service primitive (control other node functions)

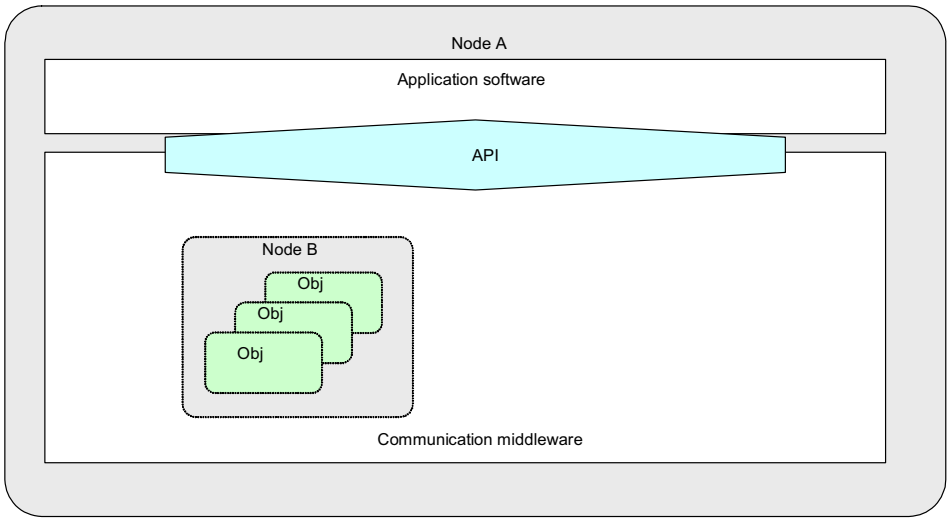


Figure B.5 – Example of object view

c) AOJs when notifying another node of self-node status

ISO/IEC 14543-4-1 provides two methods for notifying application software on another node of the status of the self-node. These methods are shown in Figure B.6 and Figure B.7. In the method shown in Figure B.6, when a request is received from an application, the specified other node (Node B) is immediately notified, and the device status need not be stored as an object in the communication middleware for the node (Node A) announcing the status. In the second method, shown in Figure B.7, upon receiving a request from an application, the Communication Middleware periodically sends notification of the property value to the other node using asynchronous timing that differs from the request from the application. Here, AOJ data actually exists in the communication middleware. In the former method (Figure B.6), however, because communication is stipulated by the application, a virtual copy of the AOJs exists in the communication middleware. In either case, from the viewpoint of the application, the AOJs of the self-node are seen as existing within the communication middleware (see Figure B.8).

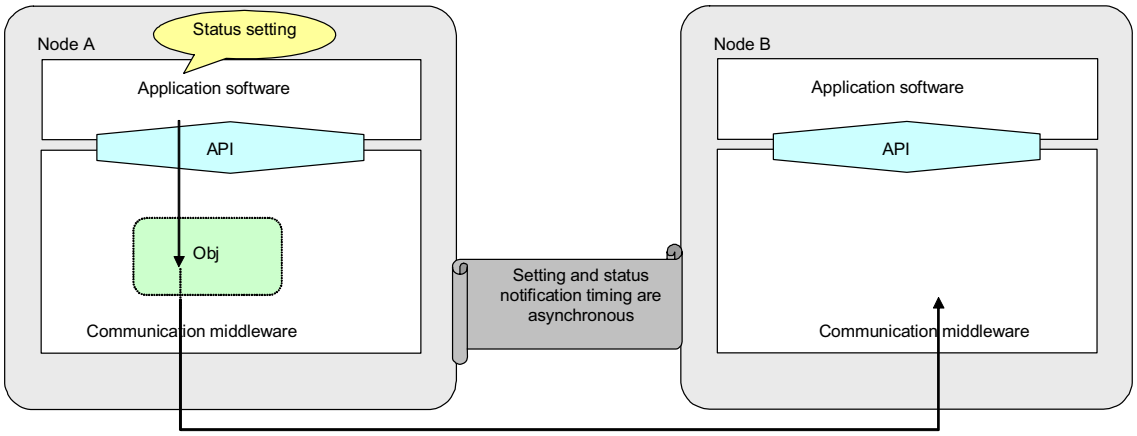


Figure B.6 – Service primitive (notify other nodes of self-node status: synchronous type)

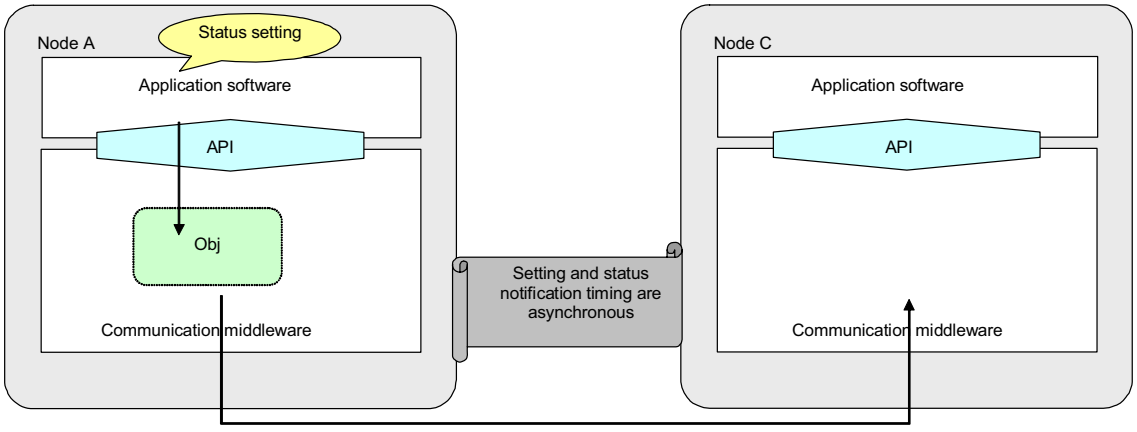


Figure B.7 – Service primitive (notify other nodes of self-node status: asynchronous type)

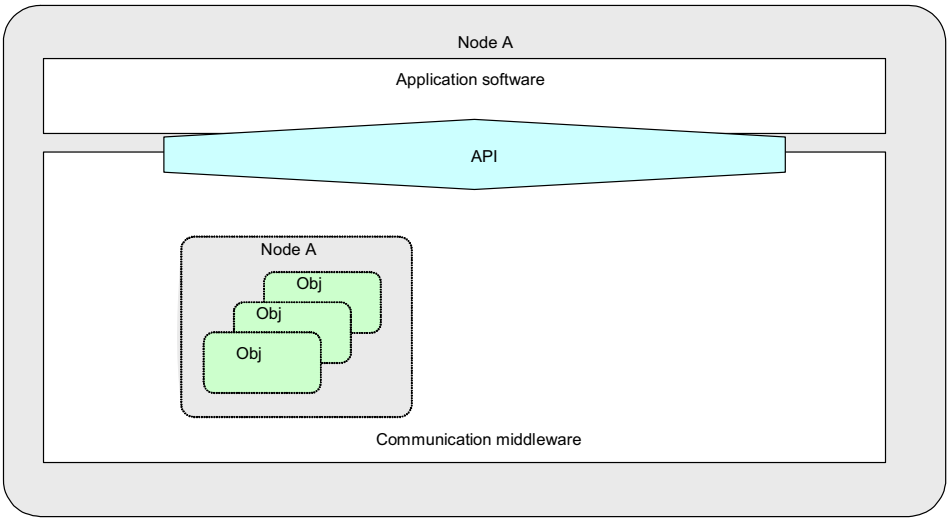


Figure B.8 – Example of object view

As is clear from the three cases shown above, the communication middleware is viewed by the application software as containing (and in some cases actually does contain): (1) a collection of AOJs of the self-node whose role is to disclose the functions of the self-node to other nodes and to be controlled by other nodes; and (2) AOJs at the node level whose role is to control and obtain the status of the functions of other nodes. Here, the self-device shall be specified as the unit for a collection of AOJ instances showing the functions of the self-node. Only one such device exists in each piece of communication middleware, but there may be as many other devices as there are other related nodes. Based on the above, Figure B.9 shows an example of an AOJ configuration in a node for a system in which an air conditioner, ventilation fan, and human detection sensor are connected as separate nodes via a network, seen from the perspective of the application software in the air conditioner.

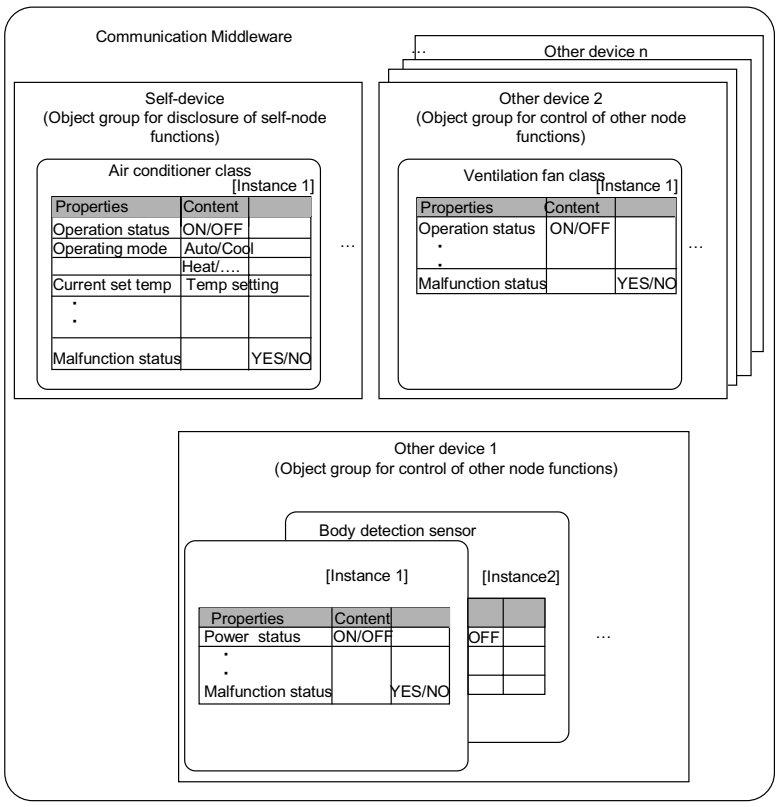


Figure B.9 – Example of AOJ configuration in a Node

Annex C
(normative)

Property map description format

When there are less than 16 properties, description format (1) is used. When there are more than 16 properties, description format (2) is used. Figure C.1 shows the property map.

- Description format (1)

  Byte 1: Number of properties displayed in binary

  Byte 2 and higher: List of property codes (1-octet code)

- Description format (2)

  Byte 1: Number of properties displayed in binary

  Bytes 2–17: In the 16-octet table below, the bit location showing existing property codes is set to 1, and properties are listed in order starting with Byte 2.

	Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7
Byte 2	80	90	A0	B0	C0	D0	E0	F0
Byte 3	81	91	A1	B1	C1	D1	E1	F1
Byte 4	82	92	A2	B2	C2	D2	E2	F2
Byte 5	83	93	A3	B3	C3	D3	E3	F3
Byte 6	84	94	A4	B4	C4	D4	E4	F4
Byte 7	85	95	A5	B5	C5	D5	E5	F5
Byte 8	86	96	A6	B6	C6	D6	E6	F6
Byte 9	87	97	A7	B7	C7	D7	E7	F7
Byte 10	88	98	A8	B8	C8	D8	E8	F8
Byte 11	89	99	A9	B9	C9	D9	E9	F9
Byte 12	8A	9A	AA	BA	CA	DA	EA	FA
Byte 13	8B	9B	AB	BB	CB	DB	EB	FB
Byte 14	8C	9C	AC	BC	CC	DC	EC	FC
Byte 15	8D	9D	AD	BD	CD	DD	ED	FD
Byte 16	8E	9E	AE	BE	CE	DE	EE	FE
Byte 17	8F	9F	AF	BF	CF	DF	EF	FF

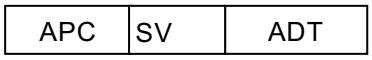
NOTE For each bit, 0 = no property; 1 = property exists.

Figure C.1 – Property map description format

Annex D
(informative)

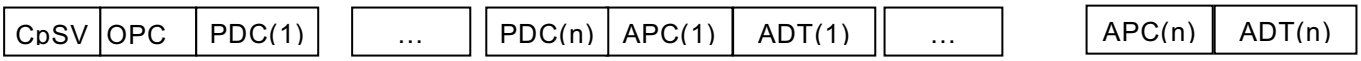
Composite messages

The packets including application property data are transmitted on the transmission media by non Composite Messages type shown in Figure D.1 or composite messages type shown in Figure D.2. Non-composite messages type includes only one set of Application Property Code, Application Property Data and Get/Set related information for the AOJ. However, composite messages type includes more than one set of Application Property Code, Application Property Data and Get/Set related information for the AOJ.



APC: Application Property Code for the AOJ
SV: Get/Set related information
ADT: Application Property Data for the Application Property Code for the AOJ

Figure D.1 – Part of the non-composite messages type packet



CpSV: Get/Set related information
OPC: Value for n
PDC(n): Size of {APC(n)+ ADT(n)}
APC(n): Application Property Code for the AOJ
ADT(n): Application Property Data for the Application Property Code for the AOJ

Figure D.2 – Part of the composite messages type packet

Annex E
(informative)

Connector shape

E.1 General

For connectors on the Network-ready equipment side, an 8-pin disconnectable crimp style connector (Type A: PH-connector type, see bibliography) is recommended. For connectors on the Network Adapter side, there is no particular requirement.

In the case where a connector is implemented, assuming consumers intending to install a Network Adapter and perform replacements etc. in the future, it is necessary to meet the following requirements:

– prevention of Mis-alignment;

– live-line plugging and unplugging function.

For this reason, a 9-pin Network Adapter connector that meets these requirements (Type B connector) is recommended as a connector for the Network-ready equipment side (Type B socket, see Figure E.1) and Network Adapter side (Type B plug, see Figure E.2) as shown in Table E.1. When the connector used is a Type B connector, the number of conductors in a multi-conductor cable can be freely determined. When a manufacturer adopts a connector, it is recommended that the Type B connector specifications be followed so that rigorous mutual compatibility is achieved.

Table E.1 – Physical specifications for Type B connector

Item	Specification	Remark
Number of poles	9	The home appliance WakeUP function is added to the 8 poles recommended by the Network Adapter specifications, as a future requirement.
Connector pin interval	2 mm	This is a value that was determined taking into consideration the power supply to adapters and home appliances and the specifications for signaling lines.
Rated current	0,5 ADC	Power supply to home appliances.
Rated voltage	15 VDC	Power supply to home appliances.
Operating temperature range	–20 °C to +85 °C	The operating temperature range is an ambient temperature range in which the connector can be used continuously at the rated voltage and current and anticipates outdoor use as well.
Storage temperature range	–40 °C to +85 °C	The storage temperature range is an ambient temperature range in which the connector can be stored with no load applied and anticipates outdoor use as well.
High-temperature resistance	・Contact resistance: Twice or less of the initial standard value ・Insulation resistance: The initial standard value should be satisfied. ・Withstand voltage: The initial standard value should be satisfied. ・External appearance: There should be no crack, deformation, or other defect.	The connector is left in a (85 ± 2) °C environment for 500 h and then in an ordinary-temperature, ordinary-humidity environment for 30 min before measurements are taken.
Low-temperature resistance	・Contact resistance: Twice or less of the initial standard value ・Insulation resistance: The initial standard value should be satisfied. ・Withstand voltage: The initial standard value should be satisfied. ・External appearance: There should be no crack, deformation, or other defect.	The connector is left in a (–40 ± 2) °C environment for 500 h and then in an ordinary-temperature, ordinary-humidity environment for 30 min before measurements are taken.
Humidity resistance	・Contact resistance: Twice or less of the initial standard value ・Insulation resistance: The initial standard value should be satisfied. ・Withstand voltage: The initial standard value should be satisfied. ・External appearance: There should be no crack, deformation, or other defect.	The connector is left in an environment with a temperature of (60 ± 2) °C and a relative humidity of 90 % to 95 % for 500 h and then in an ordinary-temperature, ordinary-humidity environment for 30 min before measurements are taken.

Item	Specification	Remark
Insulation resistance	1 000 MΩ or more	A voltage of 500 VDC is applied between the two ends of the conducting section for 1 min before measurements are taken.
Withstand voltage	There should be no arc, dielectric breakdown or other defect.	A voltage of 500 VAC is applied between the two ends of the conducting section for 1 minute before confirmation is made. Interruption current: 2 mA
Insulation	Insulation distance: 2,5 mm or more Refer to Figure E.2 (the part marked with NOTE 2).	There should be an insulation distance of 2,5 mm or more between the pins of the MA plug (charging section) and the connector opening (outer shell) (provision for auxiliary insulation).
Material	RoHS directive-compliant housing UL94 V-0 or higher with PBT glass Contact (conducting section) Copper alloy	
Shape	Type B socket (Network-ready equipment side) Type B plug (Network Adapter side) Mating section	The shape should be as shown in Figure E.1. The shape should be as shown in Figure E.2. The shape should be as shown in Figure E.3.
Mis-alignment prevention mechanism	Refer to Figure E.1 (the part marked with NOTE 1).	Mis-alignment by the user should be anticipated and a mechanism should be provided to prevent it.
Live-line plugging and unplugging function	Refer to Figure E.2 (the part marked NOTE 1).	The safety of the equipment and adapter is ensured by the timing function whereby Pin 1 contacts first during plugging and is detached last during unplugging.
Number of times of plugging and unplugging	500	
Locking mechanism	A locking mechanism (half lock) should be provided. Refer to Figure E.3 (the part marked with NOTE 1).	The unlocking strength should be about 20 N to 40 N and a function should be provided to confirm secure plugging.
Waterproofing mechanism	O-ring groove Refer to Figure E.3 (the part marked with NOTE 2).	An O-ring groove should be provided so that a waterproof and splash-proof connector can be achieved.

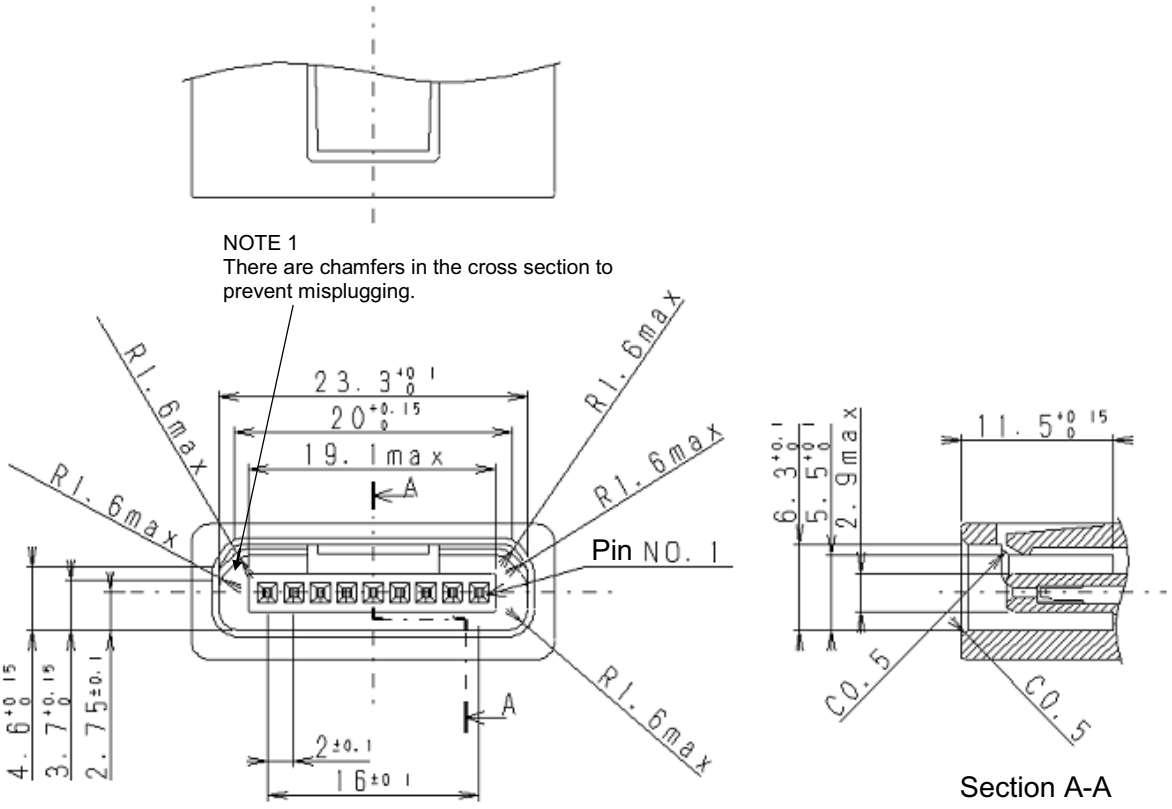


Figure E.1 – Type B Socket (Network-ready equipment side)

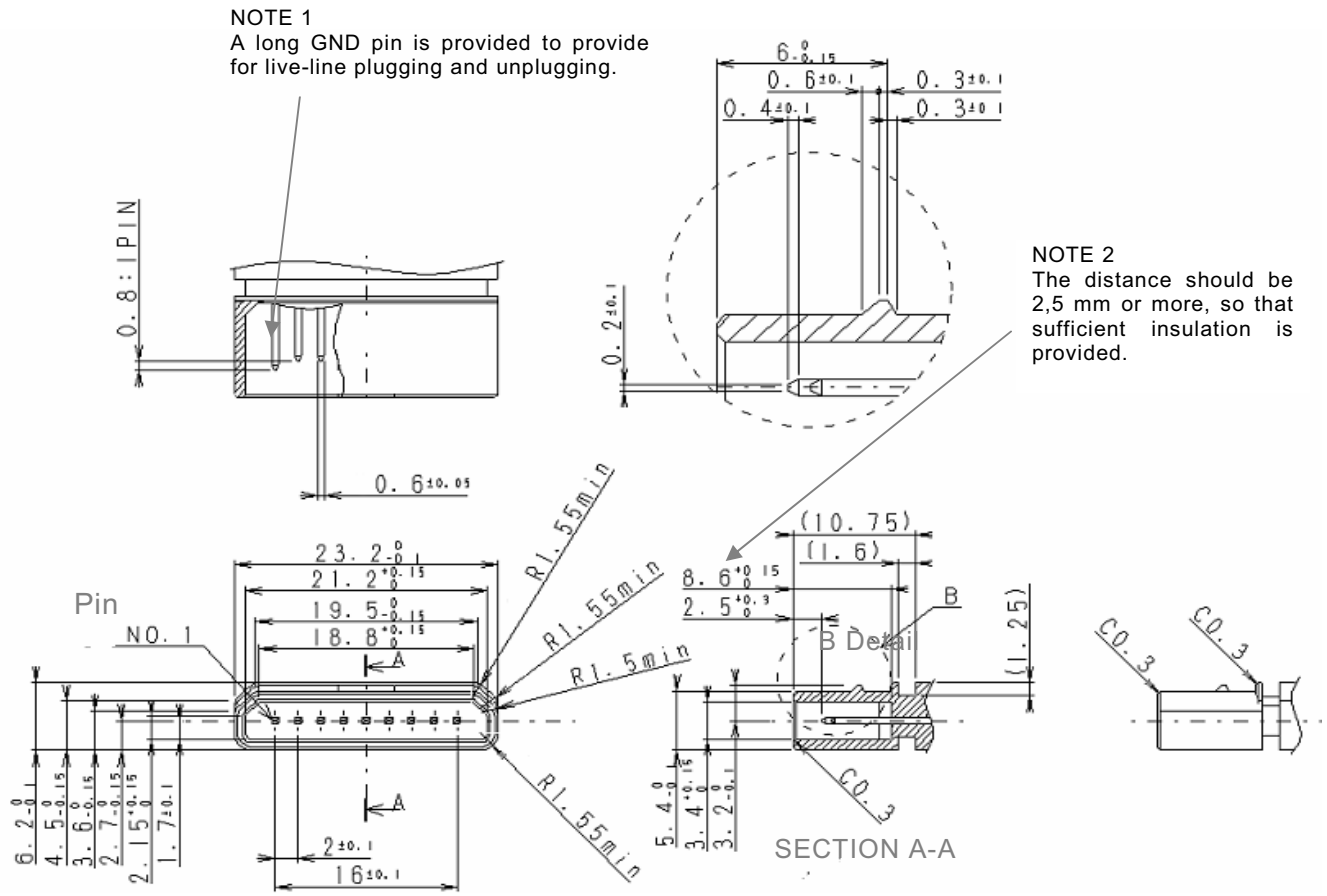


Figure E.2 – Type B plug (Network Adapter side)

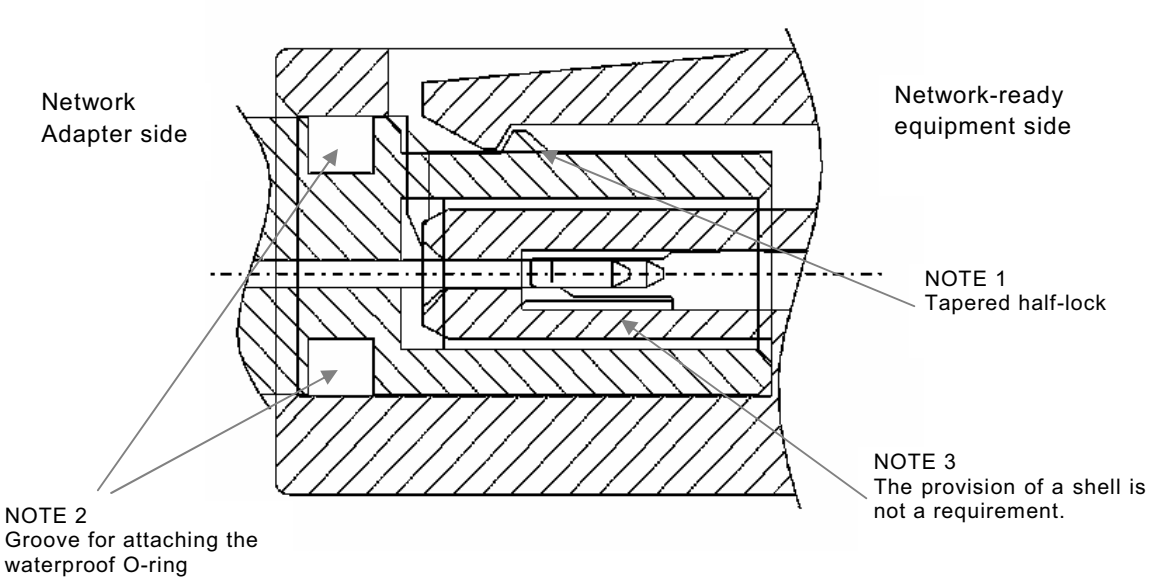


Figure E.3 – Mating of Type B connector

E.2 Relationship between the connector pins and signals

Figure E.4 shows the pin assignment for Type A connectors and Figure E.5 shows the pin assignment for the case where a Type B connector is used. Both are recommended.

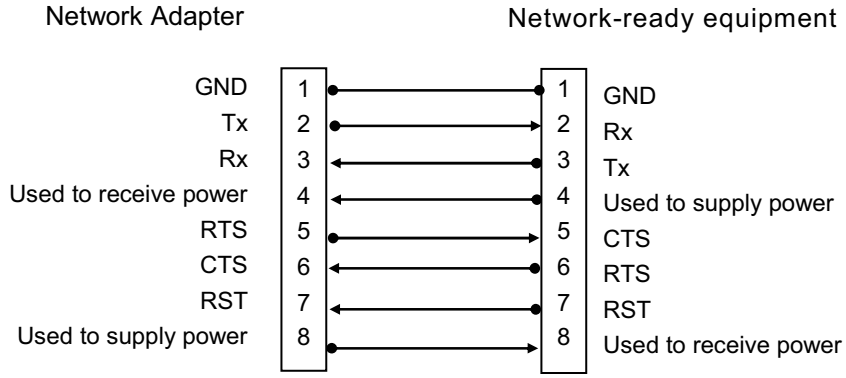


Figure E.4 – Type A connecter pin arrangement for Network Adapter communication interfaces – Pin assignment 1

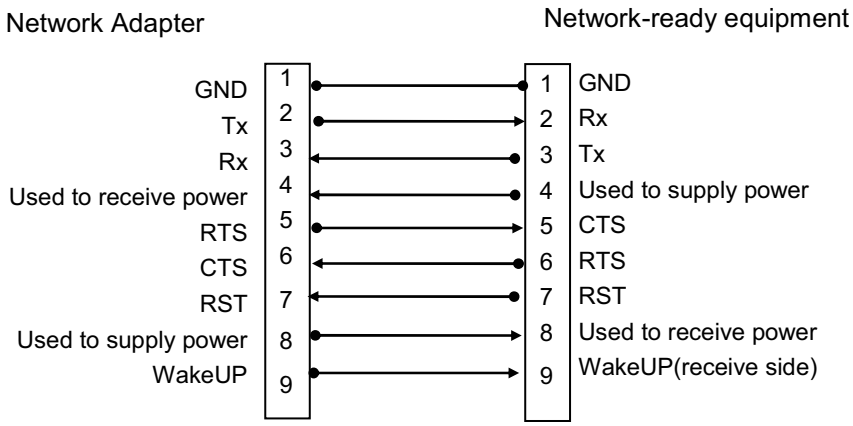


Figure E.5 – Type B connecter pin arrangement for Network Adapter communication interfaces – Pin assignment 2

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