# Part VII
# ECHONET Communications Equipment Specification

Release information (as of August 7th 2001)

| | | | |
|---|---|---|---|
| a) Version1.0 | March 18th | 2000 released | Open to the consortium member |
| | July | 2000 | Open to the public |
| b) Version1.01 | May 23rd | 2001 | Open to the public |
| c) Version2.00 | August 7th | 2001 | Open to the consortium member |

Notes: On and after Version2.00, Powerline communication protocol has drawn together as Powerline communication A.

Contents

# Chapter 1 Overview of ECHONET Communications Equipment Specification

## 1.1 Basic Concept

Part 7 provides specifications for the ECHONET Node, ECHONET device adapter, ECHONET gateway, and ECHONET router as communication equipment. Part 7 also specifies details and functional shares for the ECHONET device adapter and ECHONET device interface.

## 1.2 Communications Equipment Specification Overview of ECHONET Node

The ECHONET Node is a general term for a communication terminal that permits direct information exchange through the ECHONET network and is used for cases in which a single communication terminal is indicated without functional distinction.

The requirements for the ECHONET Node are shown below:

- ECHONET Lower-Layer Communication Software
- ECHONET Communication Middleware

## 1.3 Communications Equipment Specification Overview of ECHONET Device Adapter

The ECHONET device adapter adds a function as an ECHONET Node to a device that cannot function alone as an ECHONET Node. In this standard, an ECHONET device adapter is specified as an adapter to connect a device without ECHONET Lower-Layer Communication Software and Protocol Difference Absorption Processing Block to the ECHONET network. Accordingly, the ECHONET device adapter shall satisfy the following requirements:

- Single ECHONET Lower-Layer Communication Software
- Protocol Difference Absorption Processing Block
- Adapter Communication Software

The Adapter Communication Software is intended to perform communications between the ECHONET device adapter and a device, and its specifications are described in Section 3.

## 1.4 Communications Equipment Specification Overview of ECHONET Gateway

An ECHONET gateway is defined as an ECHONET Node acting to connect an ECHONET domain to an external network, namely, an ECHONET Node with a mandatory function of gateway basic block as service middleware. However, this ECHONET gateway need not always be a dedicated ECHONET Node provided with a gateway function; it may provide both a gateway function and some other function. Considering the ECHONET gateway as communication equipment, it is no different from an ECHONET Node. For this reason, a communication equipment specification for the ECHONET gateway is not provided separately.

## 1.5 Communications Equipment Specification Overview of ECHONET Router

The ECHONET router is an ECHONET Node that (1) connects each subnet to be controlled as a range in which ECHONET Lower-Layer Communication Software guarantees the seamless unity of MAC addresses by the ECHONET Communication Middleware protocol and (2) performs data routing processing. Like the ECHONET gateway, the ECHONET router need not always be a dedicated ECHONET Node; it may provide both this function and some other function.

Considering the ECHONET router as communication equipment, its requirements differ depending on the type of ECHONET Lower-Layer Communication Software. In the case of power lines, low-power radios, extended HBS, and LonTalk, requirement do not differ from those of ECHONET Nodes. Accordingly, the communication equipment specification of the ECHONET router is not provided separately, and the functional requirements for the ECHONET router are described in Section 5.

Considering the IrDA Control as ECHONET Lower-Layer Communication Software, the functional requirements native to IrDA Control must be satisfied for routing. General requirements are described in Section 5, and special functional requirements are described in Section 6.

# Chapter 2 ECHONET Nodes

## 2.1 Basic Concept

An ECHONET Node is specified as a communication terminal that permits direct information exchange through the ECHONET network. For a device to be recognized as an ECHONET terminal, it must be an ECHONET Node. Accordingly, the full ECHONET device, ECHONET gateway, and ECHONET router are each ECHONET Nodes.

## 2.2 Function Definition

Mandatory functions of an ECHONET Node are described below.

(1) Function to distinguish other ECHONET Nodes from the Self-node

This function is to distinguish the Self-node from other ECHONET Nodes in the same domain and to specify the Self-node on the ECHONET network. Therefore, it must be possible to specify the subnet to which the Self-node belongs using NetID, and to specify the Self-node in the subnet to which the Self-node belongs using NodeID.

(2) Input/output function with transmission media

This function inputs and outputs data via transmission media. Therefore, one or more transceivers capable of handling the ECHONET Lower-Layer Communication Software are functionally required.

(3) Data processing function

This function assembles and disassembles data in each ECHONET communications layer and inputs and outputs data between layers.

Optional functions of an ECHONET Node are described below.

(4) NetID server function

When the ECHONET network consists of multiple subnets, this function assigns a NetID to each subnet with any one ECHONET Node as a master router and distributes this NetID to the ECHONET routers.

To implement this processing, the ECHONET Node must satisfy the following two requirements.

- ECHONET Lower-Layer Communication Software
- ECHONET Communication Middleware

This is shown in Fig. 2.1. In the figure, the shaded portions are requirements.

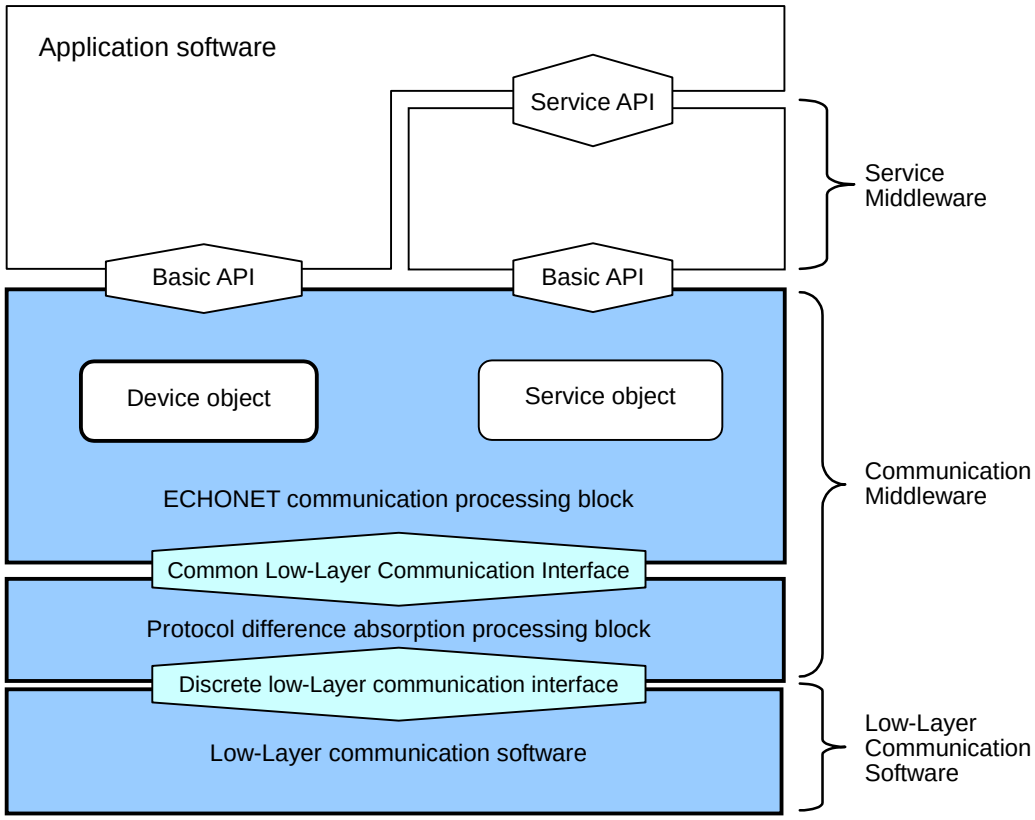



**Fig. 2.1 Requirements for ECHONET Node**

## 2.3 Mechanical and Physical Characteristics

Regarding the specification of connections with transmission media, the specification in Part 3 shall be observed in accordance with Lower-Layer Communication Protocols corresponding to the ECHONET Node. Other mechanical and physical characteristics of an ECHONET Node are specified below.

### 2.3.1 Shape

Regarding the shape, no specification shall be provided except for the connection block with the transmission media of the radio system. The shape of this connection block shall conform to the specification of the ECHONET Lower-Layer Communication Software to be used.

### 2.3.2 Display block

When an LED is equipped to display the operation status as ECHONET Node communication equipment, the following minimum requirements must be satisfied. For display methods using means not specified here, the specification native to the product shall be applicable.

- Number of LEDs
  1 (for operation status display)

- LED color
  Green

- Status display method
  Normal operation : ON
  Initial processing : Blink (long cycle)
  Error : Blink (short cycle)
  Non-operation : OFF
  * Long cycle ..... Repetition of ON for about 2 sec and OFF for about 0.5 sec
  * Short cycle ..... Repetition of ON for about 0.5 sec and OFF for about 0.5 sec

Note: Initial processing means a cold start (full reset start) and a warm start (hardware executes reset processing while keeping acquired addresses and initial setting information).

## 2.4 NetID Server Function

ECHONET Nodes with a NetID server function must be provided with a trigger switch for starting the network configuration. However, this need not be a mechanical switch. Methods using keyboard instructions or icons will not be specified here.

## 2.5 ECHONET Nodes and subnets

ECHONET Nodes can belong to only one subnet. That is, a single ECHONET Node can have only one ECHONET address. Accordingly, an ECHONET router consists of two or more ECHONET Nodes.

## 2.6 ECHONET Nodes and Domains

ECHONET Nodes cannot belong to multiple domains simultaneously. Accordingly, an ECHONET gateway for connecting two domains is defined as a device having two ECHONET Nodes (see Fig. 2.2).

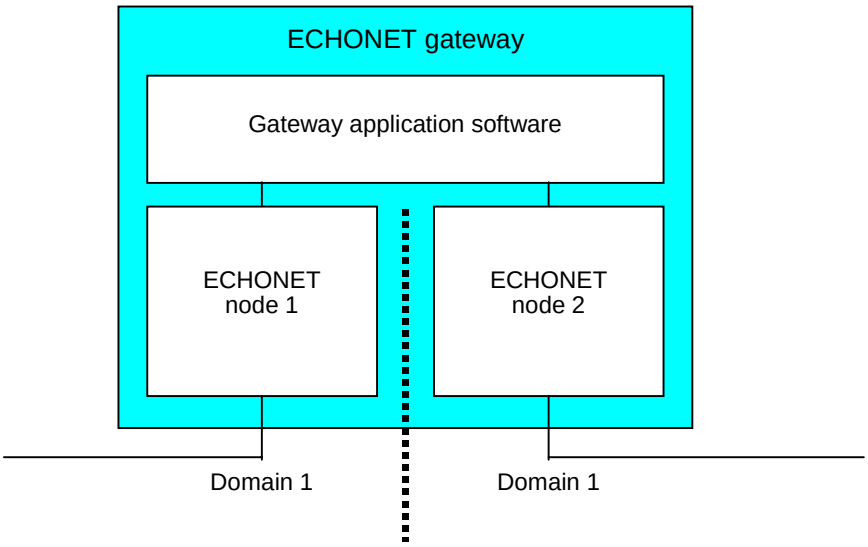



**Fig. 2.2 Relationship between ECHONET Gateway and Nodes**

## 2.7 Limitation on Number of Connections

Assuming that an ECHONET Node is considered as an address specification layer of level 2 subsequent to the subnet, the following limitation is applied:

- The maximum number of ECHONET Nodes that can exist in a single subnet is 256.
  Accordingly, the maximum value of ECHONET Nodes existing in a domain is represented by:

  $n \times m - (n-1)$

  n : Maximum number of subnets in a domain 255

  m : Maximum number of ECHONET Nodes in a subnet 256

(n–1) considers the ECHONET Nodes belonging to two subnets as a router. Substituting the values:

$255 \times 256 - (256-1) = 65{,}025$

However, this value is only the theoretical maximum and may be made smaller by limitations of the ECHONET Lower-Layer Communication Software, etc.

# Chapter 3 ECHONET Device Adapter

## 3.1 Basic Concept

In ECHONET, there are two ways of giving a device an ECHONET Node function:

(1) Accommodate the requirements for an ECHONET Node in the device itself.

(2) Add an adapter to a device that is not provided with an ECHONET Node function, thereby satisfying the requirements for the ECHONET Node.

Method (2) can be further divided into two methods based on the interface between the adapter and device:

(2-1) Use an adapter with an interface specified as the ECHONET standard.

(2-2) Use an adapter with a unique interface that is not specified in the ECHONET standard.

In the ECHONET standard, among such adapters shown in (2-1), an adapter to connect a device without ECHONET Lower-Layer Communication Software and a Protocol Difference Absorption Processing Block to the ECHONET network is specified as an ECHONET device adapter. However, only one ECHONET Lower-Layer Communication Software shall be capable of being mounted on one ECHONET device adapter.

The ECHONET device adapter is an adapter that connects a device without ECHONET Lower-Layer Communication Software and a Protocol Difference Absorption Processing Block (flex ECHONET device) to the ECHONET network. The specification of the interface between a device and an ECHONET device adapter specifies four types: a low-speed system (type 1: 600 bps) and three high-speed systems (type 2, type 3, type 4: 9600 bps). Furthermore, these types are identified by the ECHONET Lower-Layer Communication Software corresponding to the ECHONET device adapter. Accordingly, the ECHONET device adapter is indicated as shown in Fig. 3.2 by the corresponding ECHONET Lower-Layer Communication Software and transmission rate, and this shall be indicated on the ECHONET device adapter as the specification. The following are examples:

(Example 1) When the interface is of type 2 and the ECHONET Lower-Layer Communication Software corresponds to LON: EAT2-5

(Example 2) When the interface is of type 2 and the ECHONET Lower-Layer Communication Software is an extended HBS: EAT4-1

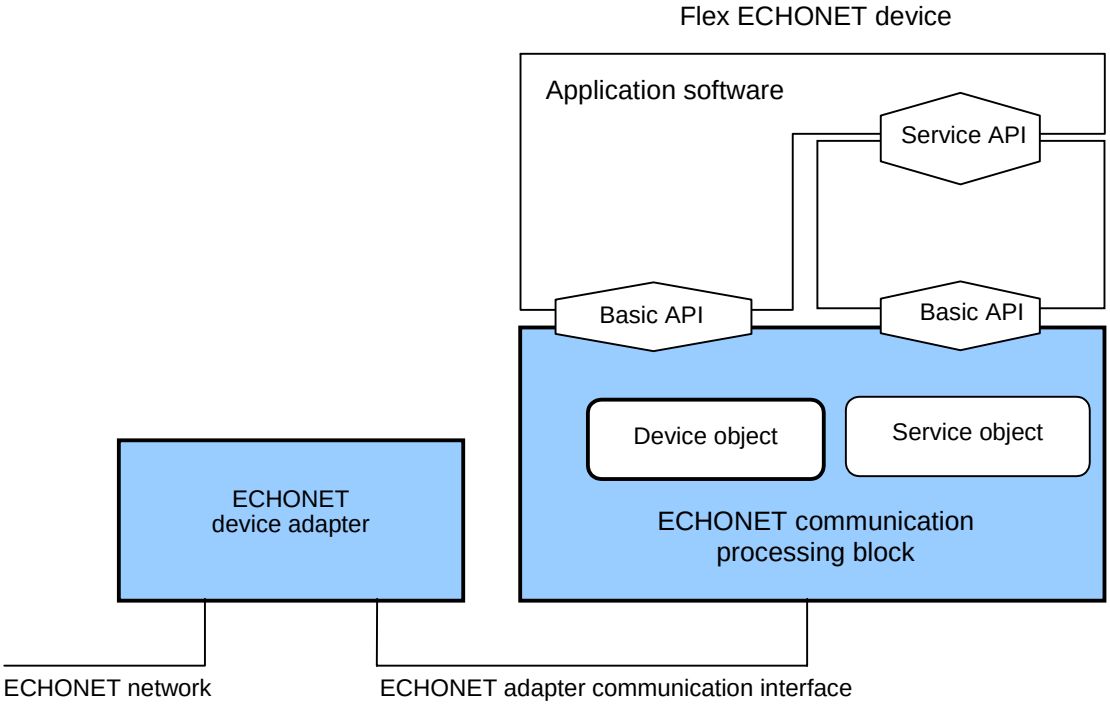



**Fig. 3.1 ECHONET Adapter and Flex ECHONET Device**

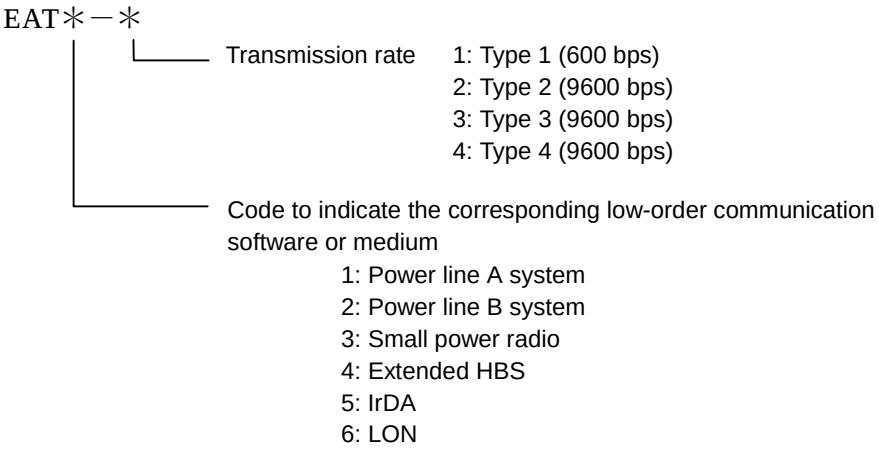



**Fig. 3.2 Type Indication of ECHONET Device Adapter**

## 3.2 Function Definition

The functions required for the ECHONET device adapter are specified as follows:

(1) Input/output function with transmission media

A function to input/output data with transmission media in accordance with the Lower-Layer Communication Protocol specification provided in Part 3. This function is executed by the ECHONET Lower-Layer Communication Software. That is, a single transceiver that can handle the ECHONET Lower-Layer Communication Protocol is required as a function.

(2) Protocol difference absorption function

A function to perform the processing specified in Part 2, Section 7 “Protocol Difference Absorption Processing Block Processing Specification”, which performs mutual translation between the ECHONET Lower-Layer Communication Software and the ECHONET Communication Processing Block Protocol. This function is executed by the Protocol Difference Absorption Processing Block.

(3) Adapter communication interface function

A function specified in 3.7 “Adapter Communication Software” in this Section. This function translates the ECHONET Communication Processing Block Protocol input from the Protocol Difference Absorption Processing Block through the common Lower-Layer Communication Interface into an Adapter Communication Interface protocol and then outputs it. In addition, this function outputs the input Adapter Communication Interface protocol into an ECHONET Communication Processing Block Protocol and then outputs it to the common Lower-Layer Communication Interface. This function is processed by the Adapter Communication Software.

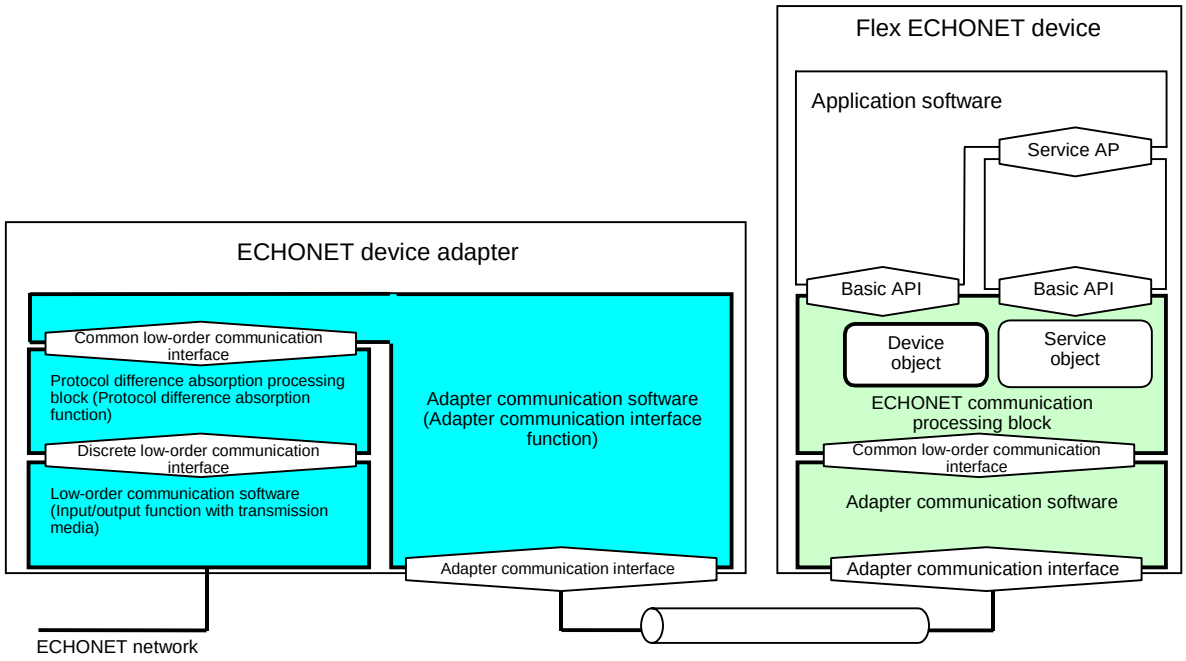



**Fig. 3.3 Functions of ECHONET Device Adapter**

## 3.3 Mechanical and Physical Characteristics

Regarding the specification of connections with transmission media, the specifications in Part 3 shall be observed in accordance with each ECHONET Lower-Layer Communication Software corresponding to the ECHONET device adapter. Specifications for connections with ECHONET devices is provided in Section 3. Other mechanical and physical characteristics of ECHONET device adapters are specified below.

### 3.3.1 Shape

Shape shall not be specified except for the connection block with the ECHONET device via the Adapter Communication Interface. The shape of the connection block shall conform to the specification of the ECHONET Lower-Layer Communication Software to be used.

### 3.3.2 Display block

When an LED is provided to display the operation status of the ECHONET device adapter, the following minimum specifications must be satisfied. For a display method using a means not specified here, the specifications native to each product shall be applicable. The operation status display is specified in Section 6.

- Number of LEDs
  1 (for operation status display)

- LED color
  Green

- Status display method
  Normal operation : ON
  Initial processing : Blink (long cycle)
  Error : Blink (Short cycle)
  Non-operation : OFF
  * Long cycle ..... Repetition of ON for about 2 sec and OFF for about 0.5 sec
  * Short cycle ..... Repetition of ON for about 0.5 sec and OFF for about 0.5 sec

Note: Initial processing means a cold start (full reset start) and a warm start (hardware executes reset processing while keeping acquired addresses and initial setting information).

## 3.4 Electrical Characteristics

Regarding the specification of connections with transmission media, the specifications in Part 3 shall be observed in accordance with each ECHONET Lower-Layer Communication Software corresponding to the ECHONET device adapter. Specifications for connections with ECHONET devices are provided in Section 6.

## 3.5 Logical Conditions

The logical conditions for Adapter Communication Software are specified in Section 6. For the logical conditions related to the ECHONET Lower-Layer Communication Software and Protocol Difference Absorption Processing Block, see Parts 3 and 2, respectively.

## 3.6 Adapter Communication Software

The Adapter Communication Software is defined as follows:

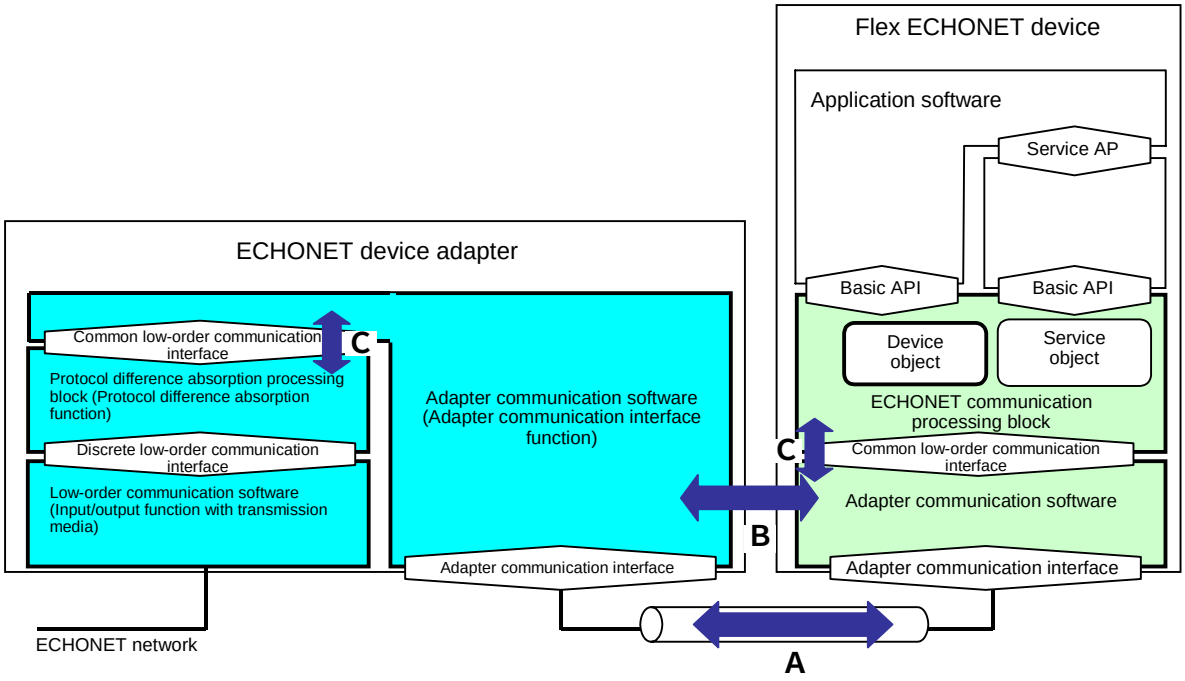
① This software runs on ECHONET devices and flex ECHONET devices.

② Differences in the common interface implementation method between the ECHONET device adapter and the flex ECHONET device are absorbed.

The Adapter Communication Software handles the Adapter Communication Software Protocol that is an intermediate step of the above translation. The Adapter Communication Interface, Adapter Communication Software Protocol, and their handling are specified below.

### 3.6.1 Overview of Adapter Communication Software

Fig. 3.4 shows data exchange by the Adapter Communication Software between the ECHONET device adapter and a device. Fig. 3.5 shows the relationship between the common lower-layer interface service, Adapter Communication Software Protocol, and Adapter Communication Interface protocol. In addition to services specified as common Lower-Layer Communication Interface services in this standard, the services originally specified by the adapter vendor shall also be handled. Distinctions between different services are made by the service header (SHD).




A: Adapter communication interface protocol
B: Adapter software protocol
C: Common low-order communication interface service

**Fig. 3.4 Data Exchange between ECHONET Device Adapter and Device**

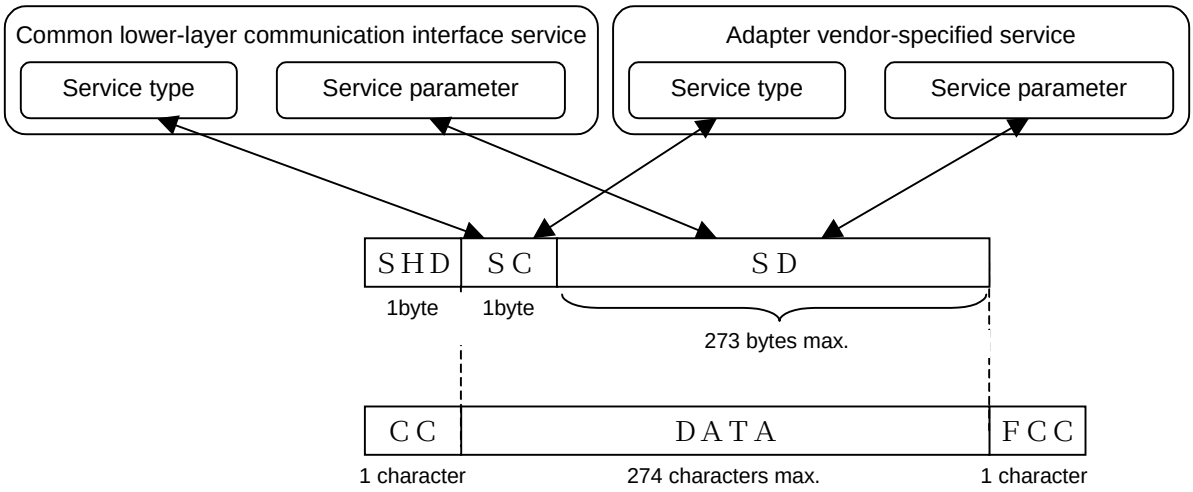



**Fig. 3.5 Relationship between Services and Protocols**

### 3.6.2 Adapter Communication Interface

The Adapter Communication Interface is an interface between the ECHONET device adapter and a device. The three items shown in the tables below are specified.

- Type 1 (Low-speed non-polarity type interface)
- Type 2 (High-speed interface)
- Type 3 (High-speed coaxial interface)
- Type 4 (RS-232C interface)

Type 1 supports a transmission rate of 600 bps, and types 2, 3, and 4 support a transmission rate of 9600 bps.

For a type 2 interface, a power feed is also possible.

### 3.6.3 Mechanical and physical characteristics of Adapter Communication Interface

The mechanical and physical characteristics of Adapter Communication Interfaces are specified below.

(1) Transmission media

Transmission media using the Adapter Communication Interface are specified in Table 3.1.

**Table 3.1 Transmission Media of Adapter Communication Interface**

| | Medium name | Number of cables | Specification |
|---|---|---|---|
| Type 1 | Twisted pair cable | 1 pair | Conductor diameter 0.65mm |
| Type 2 | Twisted pair cable | 1 pair | Conductor diameter 0.65mm |
| Type 3 | Coaxial cable | 1 cable | S-4C-FB, TVEFCX |
| Type 4 | Medium conforming to RS-232C | 5 cables | Conforming to RS-232C |

(2) Cable length

The maximum cable length that can be used for transmission media is specified in Table 3.2.

**Table 3.2 Maximum Cable Length of Transmission Media**

| | Medium name | Maximum cable length |
|---|---|---|
| Type 1 | Twisted pair cable | 30m |
| Type 2 | Twisted pair cable | 200m |
| Type 3 | Coaxial cable | 200m |
| Type 4 | Medium conforming to RS-232C | 15m |

(3) Connection form

For all types (1, 2, 3, and 4), one flex ECHONET device is used for one ECHONET device adapter per Adapter Communication Interface. In other words, a one-to-one connection is used.

(4) Connector shape

① Connector on the flex ECHONET device side

The connector shape is specified in Table 3.3.

**Table 3.3 Connector on the Flex ECHONET Device Side**

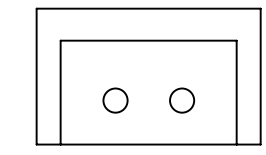
| | Connector shape |
|---|---|
| Type 1 | 2.5 mm 2-pin metric mutual connection system |
| Type 2 | Modular type 6-split 2-pin connector |
| Type 3 | Screw type RCA pin connector |
| Type 4 | 9-pin D-SUB male connector |

② Connector on the device adapter side

Not specified.

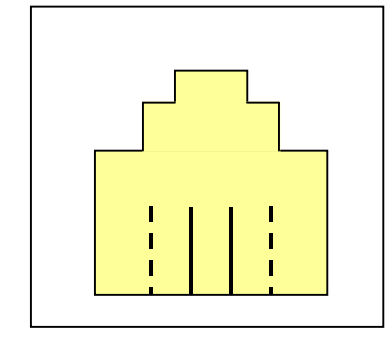
(5) Relationship between connectors and signals

Each of the following figures shows signal arrangements on the jack side and cable colors in the modular type connector specified for type 1 interface, type 2 interface, and type 4 interface respectively.




D (Black): signal line

**Fig. 3.6 Type 1 Interface**




D1 (Red) : signal and power supply (+)
D2 (Gray) : signal and power supply (–)

**Fig. 3.7 Type 2 Interface**

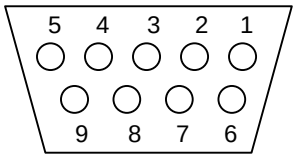



**Fig. 3.8 Type 4 Interface**

For the type 3 interface (screw type RCA pin connector), the terminals are specified as follows:

D1 (+) : Inner conductor

D2 (–) : Outer conductor

### 3.6.4 Electrical characteristics of Adapter Communication Interface

The electrical characteristics of the Adapter Communication Interface are specified below.

(1) Characteristic cable impedance (nominal value)

The characteristic cable impedance is specified in Table 3.4.

**Table 3.4 Characteristic Cable Impedance**

| | Medium name | Characteristic impedance (nominal value) |
|---|---|---|
| Type 1 | Twisted pair cable | 300Ω |
| Type 2 | Twisted pair cable | 300Ω |
| Type 3 | Coaxial cable | 75Ω |
| Type 4 | Conforming to RS-232C | Not specified |

(2) Load resistance (type 2/type 3 interface)

In type 2 and type 3 interfaces, a load resistance shall be provided on the ECHONET device adapter to suppress waveform distortion. In the type 2 interface, a condenser must be connected in series with the load resistance to cut the direct current in consideration of a power feed (see Fig. 3.9). The load resistance value is shown below.

• Load resistance value R= 39Ω

• DC cut condenser C= 10 to 47μF (type 2 interface only)

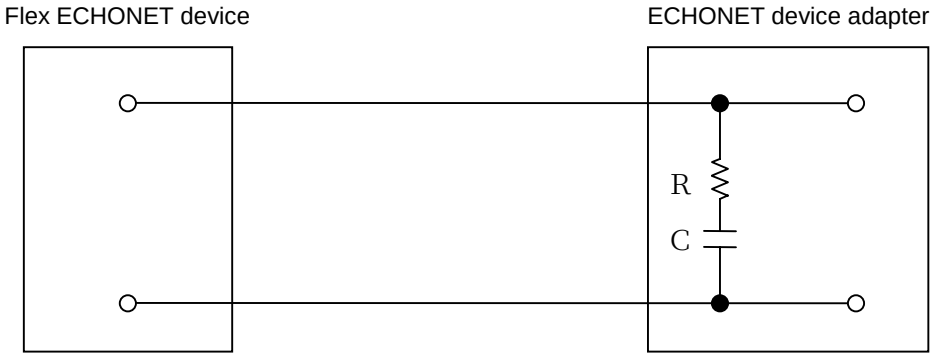



**Fig. 3.9 Load Resistance**

(3) Signal transmission rate

Signal transmission rates are specified as follows:

- Type 1 600 bps ± 1%
- Type 2 9600 bps ± 0.13%
- Type 3 9600 bps ± 0.13%
- Type 4 9600 bps ± 0.13%

(4) Signal transmission system and transmission waveform

The signal transmission system and transmission waveform are specified as follows:

◇ Type 1 and type 4

① Transmission system : Base band transmission
② Transmission waveform : NRZ
③ Logic : Negative logic

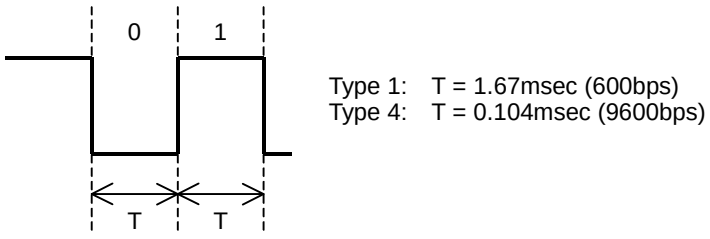



**Fig. 3.10 Signal Transmission System and Transmission Waveform of Type 1/Type 4 Adapter Communication Interface**

◇ Type 2 and type 3

① Transmission system : Base band transmission

② Transmission waveform : AMI (Alternate Mark Inversion)
Duty ratio: 50% $^{+4\%}_{-2\%}$

③ Logic : Negative logic

④ The start bit is sent out from the positive (+) side.

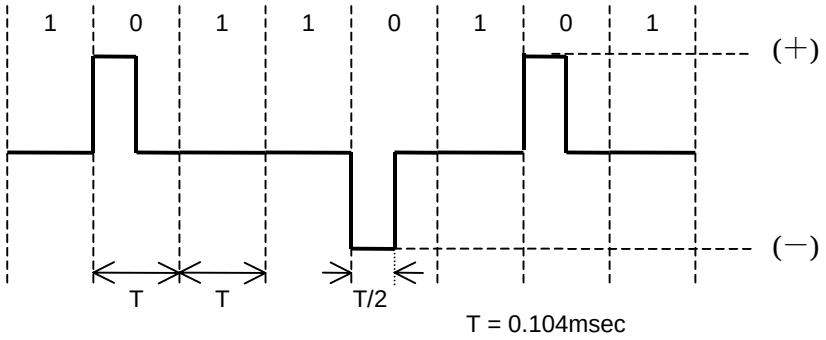



**Fig. 3.11 Signal Transmission System and Transmission Waveform of Type 2/Type 3 Adapter Communication Interface**

(4) Signal transmitting/receiving level

The electrical characteristics of the Adapter Communication Interface are specified as follows:

◇ Type 1

① ECHONET device adapter receiving level

Logic 0 transmission : 4 to 5V
Logic 1 transmission : 2.5 to 3V
Holding : 2.5 to 3V

② Device receiving level

Logic 0 transmission : 1.5 V or less
Logic 1 transmission : 2.5 to 3V
Holding : 2.5 to 3V

* Regarding the transmitting level, a value that satisfies the receiving level shall be specified in consideration of transmission loss, EMI, etc.

◇ Type 2 and type 3

Receiving level

Logic 0 transmission : 1.4 V or less

Logic 1 transmission : 0.6 or less

Holding : 0.6 or less

(Common to both ECHONET device adapter and device)

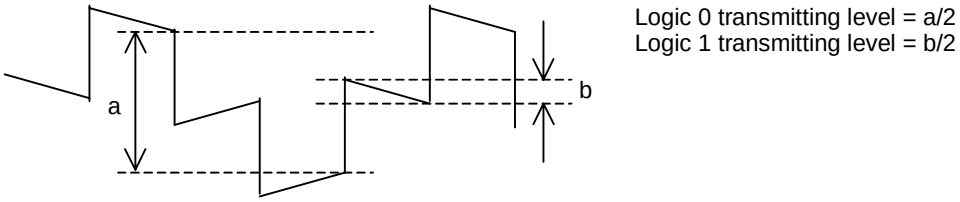



**Fig. 3.12 Signal Transmission System and Transmission Waveform of Type 2 Adapter Communication Interface**

* Regarding the transmitting level, a value that satisfies the receiving level shall be specified in consideration of transmission loss, EMI, etc.

◇ Type 4

Conforming to the RS-232C standard.

(5) Power feed (type 2 interface only)

For the type 2 interface, a DC current fed to the signal line is permitted. The power feed method is specified in Table 3.5.

**Table 3.5 Power Feed Method for Type 2 Interface**

| | |
|---|---|
| Power feed voltage | 10±1V |
| Receiving power voltage | 7 to 10V |
| Receiving power capacity | 50 mA or less |

The following requirements must be satisfied:

- The flex ECHONET device shall be a power feeder, and the ECHONET device adapter shall be a power receiver.
- A protective circuit shall be installed on the power feeder side.
- A reverse-current prevention device shall be installed in the power feeder.

### 3.6.5 Logical conditions of Adapter Communication Interface

The logical conditions for the Adapter Communication Interface are specified below.

(1) Control system

◇ Type 1, type 2 and type 3

Device-side preferential survival type CSMA/CD (Carrier Sense Multiple Access with Collision Detection)

◇ Type 4

RTS/CTS handshake

(2) Synchronization method

The synchronization is specified as follows:

Synchronization method: Start-stop synchronization

① Character structure (common to types 1 2, 3 and 4)

Start bit : 1 bit
Data : 8 bits
Parity : 1 bit
Stop bit : 1 bit (11 bits in total)

② Start bit transmitting polarity (type 2 and type 3 only)

The start bit transmitting polarity of the type 2 Adapter Communication Interface shall be the positive (+) side.

③ Data transmitting sequence (common to types 1, 2, 3, and 4)

LSB first

④ Start bit (common to types 1, 2, 3, and 4)

Logic 0

⑤ Stop bit (common to types 1, 2, 3, and 4)

Logic 1

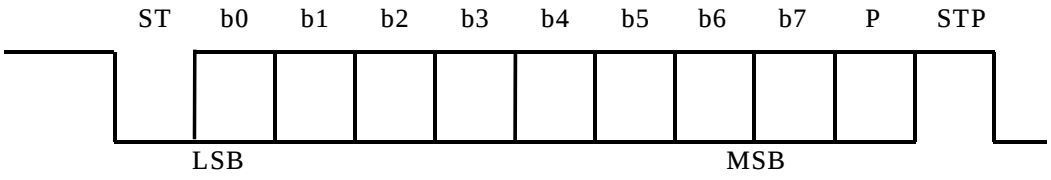
⑥ Parity (common to types 1, 2, 3, and 4)

Even parity

⑦ Character spacing (common to types 1, 2, 3, and 4)

Spacing between stop bit and next character is not allowed.

[Character structure of type 1/type 4 Adapter Communication Interface]




[Character structure of type 2/type 3 Adapter Communication Interface]

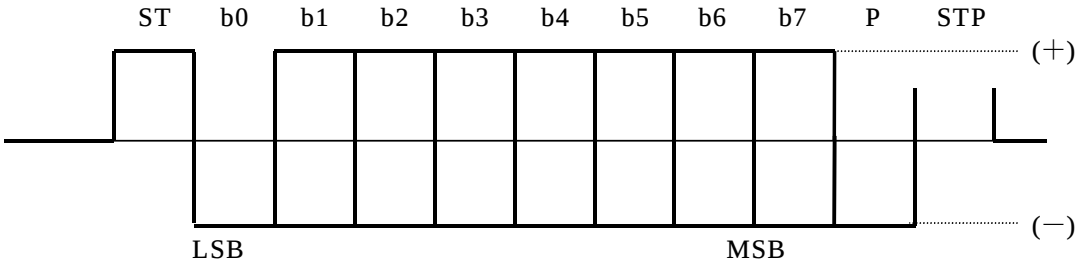



**Fig. 3.13 Character Structure of Adapter Communication Interface**

(3) Basic format of signal

The basic format of the signal, which is common to types 1, 2, 3, and 4, is specified as follows:

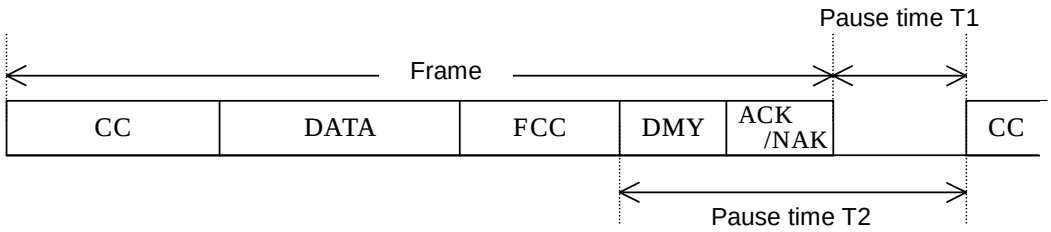



**Fig. 3.14 Basic Format of Signal**

| | |
|---|---|
| CC | : Control code |
| DATA | : Data field (274 characters max.) |
| FCC | : Check code |
| DMY | : Dummy |
| ACK/NAK | : ACK/NCK code |

(4) Pause time and pause period

The pause time and the pause period, which are common to types 1, 2, 3, and 4, are specified as follows:

① Pause time T1

◇ Type 1

Time equivalent to 1 bit from the end of ACK/NAK stop bit

18.37 msec (600 bps)

◇ Type 2, type 3, and type 4

10 msec from the end of ACK/NAK stop bit

② Pause period T2

◇ Type 1

Time equivalent to 26 bits from the end of FCC stop bit

43.42 msec (600 bps)

◇ Type 2, type 3, and type 4

Time equivalent to 22 bits + 10 msec from the end of FCC stop bit

12.29 msec

(5) Control code (CC)

The bit assignment of the control code, which is common to types 1, 2, and 3, is specified in Fig. 3.15.

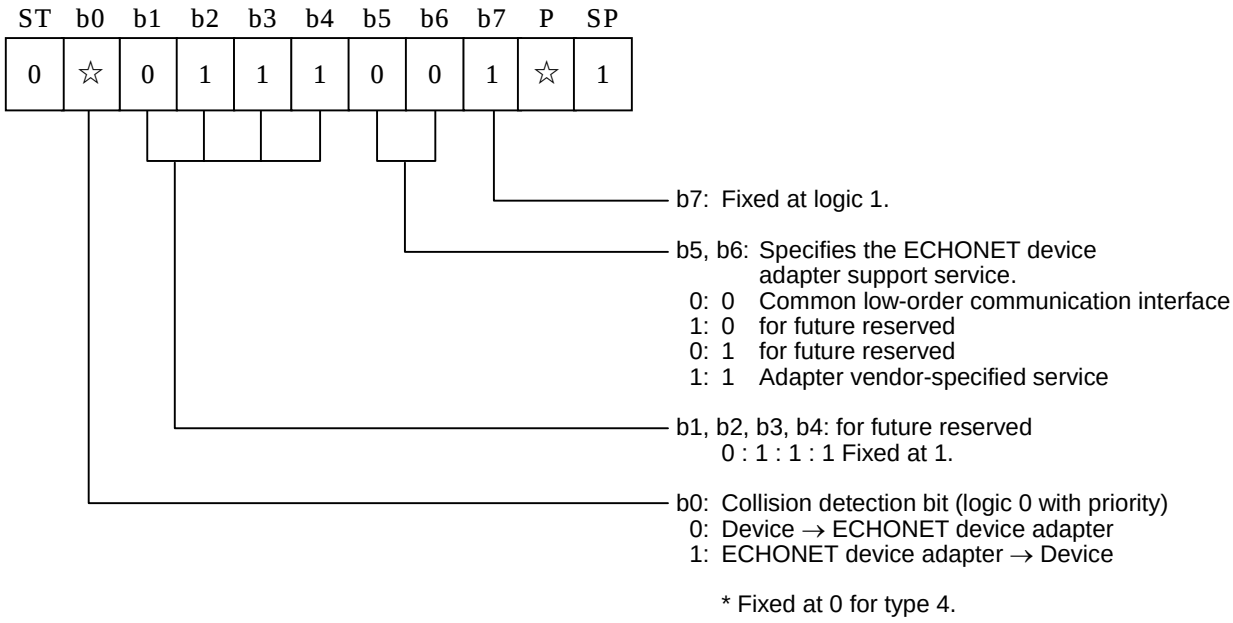



**Fig. 3.15 Control Code**

① Collision detection bit (b0)

For type 1, type 2, and type 3, when packets are sent out from both an ECHONET device adapter and a device, the surviving packet is determined as follows(for type 4, the collision detection bit is fixed at 0 and is not used as a collision detection bit):

- Collision detection bit value

  Device output packet : b0=0

  ECHONET device adapter output packet : b0=1

- Collision detection point

  Point at which a time of 1/4 bit has elapsed after transmission of collision detection bit:

  0.418 msec later (600 bps)

  0.026 msec later (9600 bps)

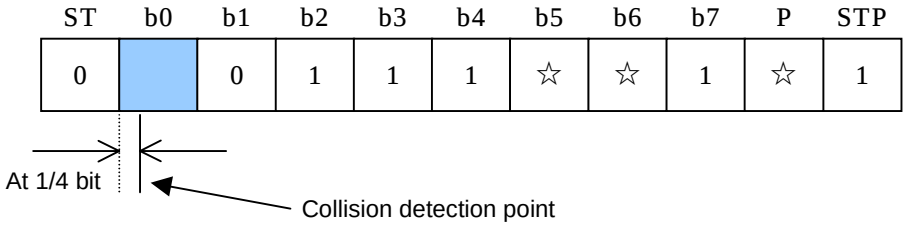



**Fig. 3.16 Collision Detection Point**

② ECHONET device adapter support specification bits (b5, b6)

These bits indicate the type of service to be carried by the packet. The following two services are specified:

- Common lower-layer interface service (b5 = 0, b6 = 0)

  Indicates that the packet is used to exchange the service specified in the common Lower-Layer Communication Interface between the flex ECHONET device and the ECHONET device adapter.

- Adapter vendor-specified service (b5 = 1, b6 = 1)

  Indicates that the packet is specified originally by the adapter vendor.

Regarding b5 = 0, b6 = 1 and b5 = 1, b6 = 0 “reserved for future use” is specified.

(6) Collision detection at contention (type 1, type 2, and type 3)

When packets are sent out simultaneously from both the ECHONET device adapter and the device, resulting in contention, the surviving packet is determined by the following procedure for types 1, 2, and 3.

① At the collision detection point, transmitted data and received data are collated.

② As a result of collation, when a mismatch is detected between the transmitted data and the received data, the transmission is stopped immediately and reception is started. Bit data of logic 0 has priority over bit data of logic 1. (The device side has priority.)

③ The loss-detected side (ECHONET device adapter side) stops transmission and starts reception. When transmission is enabled, this side starts the transmission.

* For type 4, no contention can occur because of a CTS/RTS handshake.

(7) Data division (DATA)

The data division is a device adapter software protocol divided into byte units, to each of which are added a start bit, parity, and stop bit.

(8) Check code (FCC)

The check code shall be a 2's complement of a total of character values existing in the data division for frame transmission error detection.

(9) Packet end detection

If a start bit is not detected after a stop bit is detected, it is considered to be the end of the packet.

(10) Dummy (DMY)

A dummy is assigned as an error check calculation time, as shown below. During this period, neither packet nor character exists.

◇ Type 1: Time equivalent to 2 bits
3.34 msec (600 bps)

◇ Type 2, type 3, and type 4: Time equivalent to 11 bits
1.15 msec (9600 bps)

(11) ACK/NAK

When both the device and ECHONET device adapter receive a signal of 3 characters or more in normal operation mode, error detection is performed for the received signal frame. If the signal is correctly received, the ACK signal is returned. If the signal is not correctly received, the NAK signal is returned. For ACK/NAK, the following characters are assigned:

ACK : 0x06

NAK : 0x15

(12) Error detection and error control

For types 1, 2, 3, and 4, error detection and error control are performed as follows:

① Error detection

One bit is provided as a parity for each byte, and one type is provided as a check code for the whole packet to increase the reliability of the received packet. Even parity shall be used.

② Error control

An error detection result is indicated by the ACK/NAK code subsequent to DMY. For no error, the ACK code is returned. For an error, the NAK code is returned.

- Any code other than ACK/NAK is regarded as NAK. Non-response is regarded as NAK.
- When the packet transmitting side receives NAK after DMY, it resends a packet after the pause time elapses. The maximum number of resend processing times shall be 3.

### 3.6.6 Adapter communication interface circuit (reference circuit)

Fig. 3.17 and Fig. 3.18 show, as an example, a reference circuit to implement the Adapter Communication Interface.

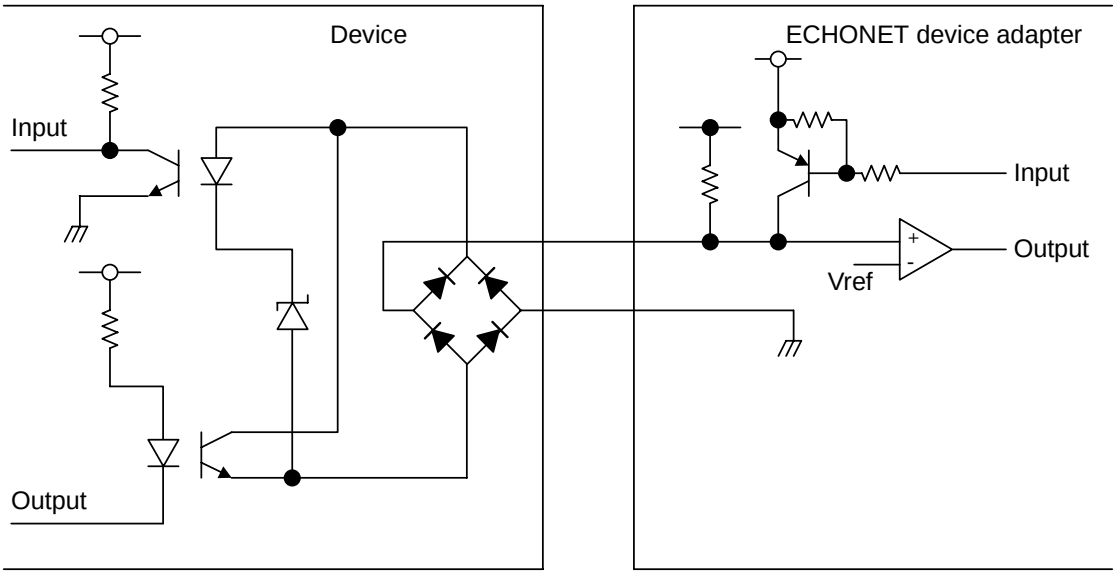
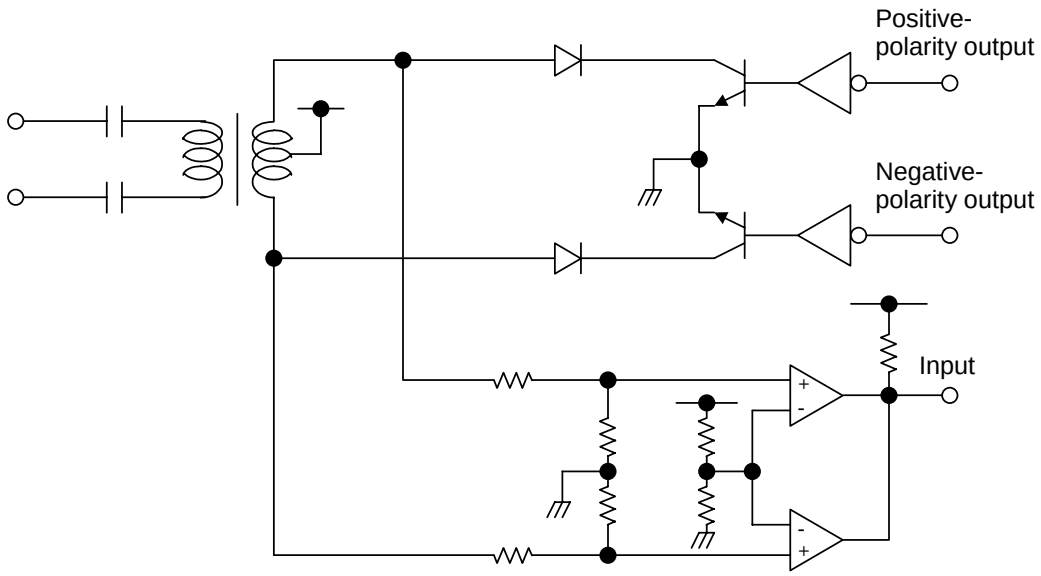



**Fig. 3.17 Example of Type 1 Adapter Communication Interface Circuit**




* Common circuit for both device and ECHONET device adapter

**Fig. 3.18 Type 2/Type 3 Adapter Communication Interface Reference Circuit**

### 3.6.7 Adapter Communication Software Protocol

The Adapter Communication Software Protocol configuration is specified in Fig. 3.19. The service code (SC) and service data (SD) comprise DATA of the Adapter Communication Interface protocol, and the service header (SHD) becomes CC in the Adapter Communication Interface protocol.

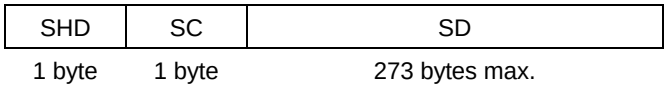



**Fig. 3.19 Adapter Communication Software Protocol**

(1) Service header (SHD)

The service header indicates the type of service code (SC) and is specified in Fig. 3.20.

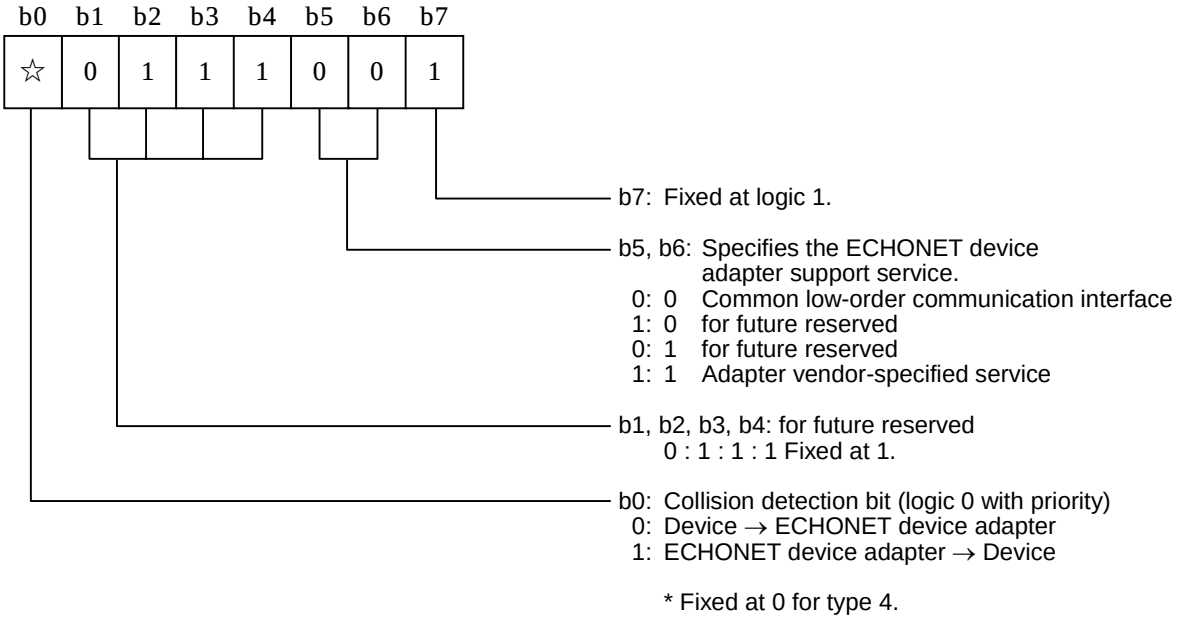



**Fig. 3.20 Service Header**

(2) Service code (SC)

The service code is a 1-byte code that specifies the common Lower-Layer Communication Interface or a service (prototype) originally specified by the adapter vendor. In this standard, 17 service codes, 0x00 to 0x10, are specified in Table 3.6 to corresponding to common Lower-Layer Communication Interface services. Service codes 0x20 to 0x30 are used to return a response as a result of services 0x00 to 0x10. The service code 0x3f is a response for a service that cannot be processed. For an optional common Lower-Layer Communication Interface service, the service is mounted on the service requesting source, but may not be processed on the processing side. In such a case, this is notified by a non-processable service notice (0x3f). The shaded codes in the Table shall be mandatory services to be mounted.

## Table 3.6 Service Codes of Common Low Layer Communication Interface Services

| 4 high-order bits \ 4 high-order bits | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Request for Lower-Layer Communication Software mounting information | Request for NodeID setting | Processing result of request for Lower-Layer Communication Software mounting information | Response of NodeID setting request processing | | | | | | | | | | | |
| 1 | Request for initialization | | Response of initialize processing | | | | | | | | | | | | |
| 2 | Request for operation start | | Response of operation start processing | | | | | | | | | | | | |
| 3 | Fault notice | | Response of fault notice processing | | | | | | | | | | | | |
| 4 | Request for reset | | Response of reset processing | | | | | | | | | | | | |
| 5 | Request for suspension | | Response of suspend processing | | | | | | | | | | | | |
| 6 | Request for operation restart | | Response of operation restart processing | | | | | | | | | | | | |
| 7 | Protocol Difference Absorption Processing Block profile acquisition | | Result of Protocol Difference Absorption Processing Block profile acquisition | | | | for future reserved | | | | | | | | |
| 8 | Lower-layer communication software profile acquisition | | Response of Lower-Layer Communication Software profile get processing | | | | | | | | | | | | |
| 9 | Protocol Difference Absorption Processing Block status acquisition | | Response of Protocol Difference Absorption Processing Block status get processing | | | | | | | | | | | | |
| A | Lower-layer communication software status acquisition | | Response of Lower-Layer Communication Software status get processing | | | | | | | | | | | | |
| B | Request for data transmission | | Response of data transmit processing | | | | | | | | | | | | |
| C | Transmission result acquisition | | Response of transmission result get processing | | | | | | | | | | | | |
| D | Request for transmission stop | | Response of transmission stop processing | | | | | | | | | | | | |
| E | Request for received data | | Response of received data processing | | | | | | | | | | | | |
| F | NodeID acquisition request | | Response of NodeID acquisition request processing | Non-processable service notice | | | | | | | | | | | |

(3) Service data (SD)

Service data is data for common lower-layer communication services or for services originally specified by the adapter vendor. For the common Lower-Layer Communication Interface, the data corresponds to the argument of API. Each unit of service data consists of two fields, namely, a data length field (LF) and a data field (DF). The data length field is 1 byte long and indicates the number of bytes comprising the data field. The data field is a field for input/output data specified in the common Lower-Layer Communication Interface. A data array of 2 bytes or more is regarded as a big endian. Fig. 3.2 shows a service data structure.

Regarding service data that is optional and not supported, the data field length value shall be 0x00, and the next service data length field shall continue immediately after it.

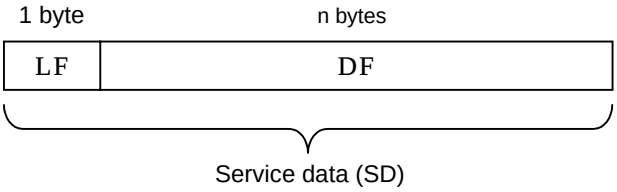



**Fig. 3.21 Service Data Format**

The service data corresponding to each service code is shown together with the Adapter Communication Software Protocol. Shaded service data shall be mandatory and must be mounted. In Fig. 3.21, the number of bytes is for cases in which service data is supported. Service data that is optional and not supported has only 1 byte in the data length field and no data field.

① Lower-layer communication software mounting information request service

◇ Service direction

Flex ECHONET device → ECHONET device adapter

◇ Service request

| 1 byte | 1 byte | 2 bytes |
|---|---|---|
| SHD | SC | SD(0) |

SHD : 0x39
SC : 0x00
SD(0) : LF 0x01 DF Dummy (0x88)

◇ Processing result

| 1 byte | 1 byte | 2 bytes | 2 bytes | n + 1 bytes |
|---|---|---|---|---|
| SHD | SC | SD(0) | SD(1) | SD(2) |

SHD ：0xB9
SC ：0x20
SD(0) ：LF 0x01 DF Processing result (0x00：TRUE, 0x01:FALSE)
SD(1) ：LF 0x01 DF Number of mounted low-order communication software (device_num)
SD(2) ：LF n DF Low-order communication software ID (device_id)
※n＝device_num

device_id
0x11～0x1F Power line A system
0x21～0x2F Power line B system
0x31～0x3F Specific small power radio
0x41～0x4F Extended HBS
0x51～0x5F IrDA_Control
0x61～0x6F LON

② Initialization request service

◇ Service direction

Flex ECHONET device → ECHONET device adapter

◇ Service request

| 1 byte | 1 byte | 2 bytes | 3 bytes | 3 bytes | 3 bytes | 3 bytes | 2 bytes |
|---|---|---|---|---|---|---|---|
| SHD | SC | SD(0) | SD(1) | SD(2) | SD(3) | SD(3) | SD(5) |

SHD ：0x39
SC ：0x01
SD(0) ：LF 0x01 DF Low-order communication software ID (device_id)
SD(1) ：LF 0x02 DF Transmitting buffer size (in bytes)
SD(2) ：LF 0x02 DF Receiving buffer size (in bytes)
SD(3) ：LF 0x02 DF Maximum holding time for transmission data (msec)
SD(4) ：LF 0x02 DF Maximum holding time for received data (msec)
SD(5) ：LF 0x01 DF Operation mode specification

◇ Processing result

| 1 byte | 1 byte | 2 bytes |
|---|---|---|
| SHD | SC | SD(0) |

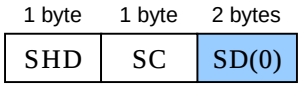
SHD ：0xB9
SC ：0x21
SD(0) ：LF 0x01 DF Processing result (0x00：TRUE, 0x01：FALSE)

③ Operation start request service

◇ Service direction

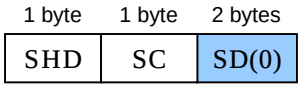
Flex ECHONET device → ECHONET device adapter

◇ Service request




SHD ：0x39
SC ：0x02
SD(0) ：LF 0x01 DF Low-order communication software ID (device_id)

◇ Processing result



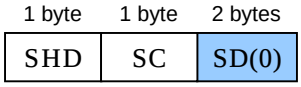

SHD ：0xB9
SC ：0x22
SD(0) ：LF 0x01 DF Processing result (0x00：TRUE, 0x01：FALSE)

④ Fault notice service

◇ Service direction

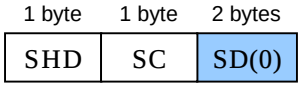
Flex ECHONET device → ECHONET device adapter

◇ Service request




SHD ：0x39
SC ：0x03
SD(0) ：LF 0x01 DF Trouble No. (trouble_no)

◇ Processing result



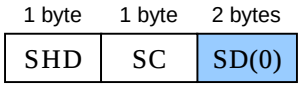

SHD ：0xB9
SC ：0x23
SD(0) ：LF 0x01 DF Processing result (0x00：TRUE, 0x01：FALSE)

⑤ Reset request service

◇ Service direction

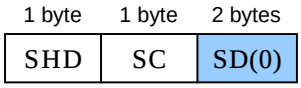
Flex ECHONET device → ECHONET device adapter

◇ Service request




SHD ：0x39
SC ：0x04
SD(0) ：LF 0x01 DF Low-order communication software ID (device_id)

◇ Processing result



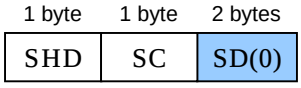

SHD ：0xB9
SC ：0x24
SD(0) ：LF 0x01 DF Processing result (0x00：TRUE, 0x01：FALSE)

⑥ Suspension request service

◇ Service direction

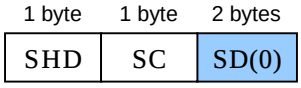
Flex ECHONET device → ECHONET device adapter

◇ Service request




SHD ：0x39
SC ：0x05
SD(0) ：LF 0x01 DF Low-order communication software ID (device_id)

◇ Processing result




SHD ：0xB9
SC ：0x25
SD(0) ：LF 0x01 DF Processing result (0x00：TRUE, 0x01：FALSE)

⑦ Operation restart request service

◇ Service direction

Flex ECHONET device → ECHONET device adapter

◇ Service request

| 1 byte | 1 byte | 2 bytes |
|---|---|---|
| SHD | SC | SD(0) |

SHD : 0x39
SC : 0x06
SD(0) : LF 0x01 DF Low-order communication software ID (device_id)

◇ Processing result

| 1 byte | 1 byte | 2 bytes |
|---|---|---|
| SHD | SC | SD(0) |

SHD : 0xB9
SC : 0x26
SD(0) : LF 0x01 DF Processing result (0x00：TRUE, 0x01：FALSE)

⑧ Protocol Difference Absorption Processing Block profile acquisition service

◇ Service direction

Flex ECHONET device → ECHONET device adapter

◇ Service request

| 1 byte | 1 byte | 2 bytes |
|---|---|---|
| SHD | SC | SD(0) |

SHD : 0x39
SC : 0x07
SD(0) : LF 0x01 DF Dummy (0x88)

◇ Processing result

| 1 byte | 1 byte | 2 bytes | 4 bytes | 4 bytes | 3 bytes | 3 bytes |
|---|---|---|---|---|---|---|
| SHD | SC | SD(0) | SD(1) | SD(2) | SD(3) | SD(4) |

SHD : 0xB9
SC : 0x27
SD(0) : LF 0x01 DF Processing result (0x00：TRUE, 0x01：FALSE)
SD(1) : LF 0x03 DF Protocol difference absorption processing block version No. (Version_No)
SD(2) : LF 0x03 DF Maker information (company_name)
SD(3) : LF 0x02 DF Number of transmittable data bytes
SD(4) : LF 0x02 DF Number of receivable data bytes

⑨ Lower-layer communication software profile acquisition service

◇ Service direction

Flex ECHONET device → ECHONET device adapter

◇ Service request

| 1 byte | 1 byte | 2 bytes |
|---|---|---|
| SHD | SC | SD(0) |

SHD : 0x39
SC : 0x08
SD(0) : LF 0x01 DF Low-order communication software ID (device_id)

◇ Processing result

| 1 byte | 1 byte | 2 bytes | 2 bytes | 4 bytes | 2 bytes | 7 bytes | 2 bytes |
|---|---|---|---|---|---|---|---|
| SHD | SC | SD(0) | SD(1) | SD(2) | SD(3) | SD(4) | SD(5) |

| 4 bytes | 3 bytes | 3 bytes | 2 bytes | 2 bytes |
|---|---|---|---|---|
| SD(6) | SD(7) | SD(8) | SD(9) | SD(10) |

SHD : 0xB9
SC : 0x28
SD(0) : LF 0x01 DF Processing result (0x00：TRUE, 0x01：FALSE)
SD(1) : LF 0x03 DF Low-order communication software version information (Version_No)
SD(2) : LF 0x03 DF Maker information (company_name)
SD(3) : LF 0x01 DF Mac address bit length
SD(4) : LF 0x06 DF Mac address information (mac_address)
SD(5) : LF 0x01 DF House code bit length
SD(6) : LF 0x03 DF House code information
SD(7) : LF 0x02 DF Number of transmittable data bytes
SD(8) : LF 0x02 DF Number of receivable data bytes
SD(9) : LF 0x01 DF Existence/non-existence of broadcast function (0x00: Nonexistence, 0x01: Existence)
SD(10) : LF 0x02 DF Transmission rate (bps)

⑩ Protocol Difference Absorption Processing Block status acquisition service

◇ Service direction

Flex ECHONET device → ECHONET device adapter

◇ Service request

| 1 byte | 1 byte | 2 bytes |
|---|---|---|
| SHD | SC | SD(0) |

SHD : 0x39
SC : 0x09
SD(0) : LF 0x01 DF Low-order communication software ID (device_id)

◇ Processing result

| 1 byte | 1 byte | 2 bytes | 2 bytes | 2 bytes | 2 bytes | 2 bytes |
|---|---|---|---|---|---|---|
| SHD | SC | SD(0) | SD(1) | SD(2) | SD(3) | SD(4) |

SHD : 0xB9
SC : 0x29

| | | | | |
|---|---|---|---|---|
| SD(0) | : LF | 0x01 | DF | Processing result (0x00 : TRUE, 0x01 : FALSE) |
| SD(1) | : LF | 0x01 | DF | Protocol difference absorption processing block transition state information (state) |
| SD(2) | : LF | 0x01 | DF | Protocol high-order layer fault (upper_trouble) |
| SD(3) | : LF | 0x01 | DF | Protocol difference absorption processing block fault (low_trouble) |
| SD(4) | : LF | 0x01 | DF | Protocol difference absorption processing block operation mode (low_mode) |

⑪ Lower-layer communication software status acquisition service

◇ Service direction

Flex ECHONET device → ECHONET device adapter

◇ Service request

| 1 byte | 1 byte | 2 bytes |
|---|---|---|
| SHD | SC | SD(0) |

SHD : 0x39
SC : 0x0A

| | | | | |
|---|---|---|---|---|
| SD(0) | : LF | 0x01 | DF | Low-order communication software ID (device_id) |

◇ Processing result

| 1 byte | 1 byte | 2 bytes | 2 bytes | 2 bytes | 2 bytes |
|---|---|---|---|---|---|
| SHD | SC | SD(0) | SD(1) | SD(2) | SD(3) |

SHD : 0xB9
SC : 0x2A

| | | | | |
|---|---|---|---|---|
| SD(0) | : LF | 0x01 | DF | Processing result (0x00 : TRUE, 0x01 : FALSE) |
| SD(1) | : LF | 0x01 | DF | Low-order communication software transition state information (state) |
| SD(2) | : LF | 0x01 | DF | Low-order communication software fault (low_trouble) |
| SD(3) | : LF | 0x01 | DF | Protocol difference absorption processing block operation mode (low_mode) |

⑫ Data transmission request service

◇ Service direction

Flex ECHONET device → ECHONET device adapter

◇ Service request

| 1 byte | 1 byte | 2 bytes | 2 bytes | 2 bytes | 3 bytes | |
|---|---|---|---|---|---|---|
| SHD | SC | SD(0) | SD(1) | SD(2) | SD(3) | SD(4) |

SHD : 0x39
SC : 0x0B

| | | | | |
|---|---|---|---|---|
| SD(0) | : LF | 0x01 | DF | Low-order communication software ID (device_id) |
| SD(1) | : LF | 0x01 | DF | Transmitting destination NodeID information |
| SD(2) | : LF | 0x01 | DF | Broadcast specification information |
| SD(3) | : LF | 0x02 | DF | Number of transmittable data bytes (data_len) |
| SD(4) | : LF | n | DF | Transmission data (send_data)<br>n = data_len (0xFF for 255 bytes or more) |

◇ Processing result

| 1 byte | 1 byte | 2 bytes |
|---|---|---|
| SHD | SC | SD(0) |

SHD : 0xB9
SC : 0x2B

| | | | | |
|---|---|---|---|---|
| SD(0) | : LF | 0x01 | DF | Processing result (0x00: Buffer full, 0x01: Transmission acceptable, 0x02: Buffer size error, 0x03: Low-order communication software error) |

⑬ Transmission result acquisition service

◇ Service direction

Flex ECHONET device → ECHONET device adapter

◇ Service request

| 1 byte | 1 byte | 2 bytes |
|---|---|---|
| SHD | SC | SD(0) |

SHD : 0x39
SC : 0x0C

| | | | | |
|---|---|---|---|---|
| SD(0) | : LF | 0x01 | DF | Low-order communication software ID (device_id) |

◇ Processing result

| 1 byte | 1 byte | 2 bytes | 2 bytes |
|---|---|---|---|
| SHD | SC | SD(0) | SD(1) |

SHD : 0xB9
SC : 0x2C
SD(0) : LF 0x01 DF Processing result (0x00: Transmission stop, 0x01: Normal, 0x02: Transmitting status, 0x03: Low-order communication software error)
SD(1) : LF 0x01 DF Transmission result (0x00: Success in transmission, 0x01: Failure in transmission, 0xFF: No response)

⑭ Transmission stop request service

◇ Service direction

Flex ECHONET device → ECHONET device adapter

◇ Service request

| 1 byte | 1 byte | 2 bytes |
|---|---|---|
| SHD | SC | SD(0) |

SHD : 0x39
SC : 0x0D
SD(0) : LF 0x01 DF Low-order communication software ID (device_id)

◇ Processing result

| 1 byte | 1 byte | 2 bytes |
|---|---|---|
| SHD | SC | SD(0) |

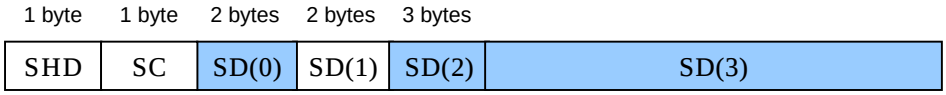
SHD : 0xB9
SC : 0x2D
SD(0) : LF 0x01 DF Processing result (0x00: Termination of transmission, 0x01: Normal, 0x03: Low-order communication software error)

⑮ Data reception request service

◇ Service direction

Flex ECHONET device → ECHONET device adapter

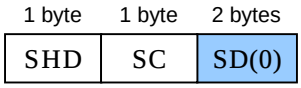
◇ Service request




SHD : 0xB9
SC : 0x0E

| | | | | |
|---|---|---|---|---|
| SD(0) | : LF | 0x01 | DF | Low-order communication software ID (device_id) |
| SD(1) | : LF | 0x01 | DF | Transmitting source NodeID |
| SD(2) | : LF | 0x02 | DF | Number of received data bytes |
| SD(3) | : LF | n | DF | Received data (receive_data)<br>n = data_len (0xFF for 255 bytes or more) |

◇ Processing result




SHD : 0x39
SC : 0x2E

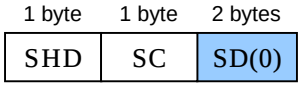
| | | | | |
|---|---|---|---|---|
| SD(0) | : LF | 0x01 | DF | Processing result (0x00 : TRUE, 0x01 : FALSE) |

⑯ NodeID acquisition service

◇ Service direction

Flex ECHONET device → ECHONET device adapter

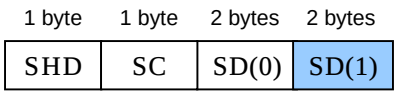
◇ Service request




SHD : 0x39
SC : 0x0F

| | | | | |
|---|---|---|---|---|
| SD(0) | : LF | 0x01 | DF | Low-order communication software ID (device_id) |

◇ Processing result




SHD : 0xB9
SC : 0x2F

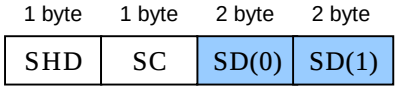
| | | | | |
|---|---|---|---|---|
| SD(0) | : LF | 0x01 | DF | Processing result (0x00 : TRUE, 0x01 : FALSE) |
| SD(1) | : LF | 0x01 | DF | NodeID |

⑰ NodeID setting service

◇ Service direction

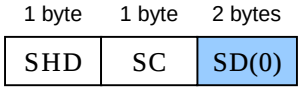
Flex ECHONET device → ECHONET device adapter

◇ Service request




SHD ：0x39
SC ：0x10
SD(0) ：LF 0x01 DF Low-order communication software ID (device_id)
SD(1) ：LF 0x01 DF NodeID

◇ Processing result



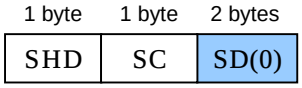

SHD ：0xB9
SC ：0x30
SD(0) ：LF 0x01 DF Processing result (0x00：TRUE, 0x01：FALSE)

⑱ Non-processable service notice

◇ Service direction

Flex ECHONET device ⇔ ECHONET device adapter

◇ Notice format




SHD ：0x39 or 0xB9
SC ：0x3F
SD(0) ：LF 0x01 DF Requested service code

### 3.6.8 Protocol translate processing

The translate processing to be performed between the Adapter Communication Software Protocol (ACSP) and the Adapter Communication Interface protocol (ACIP) is specified as follows:

(1) Translation from ACSP to ACIP

Translation processing is shown in Fig. 3.22.

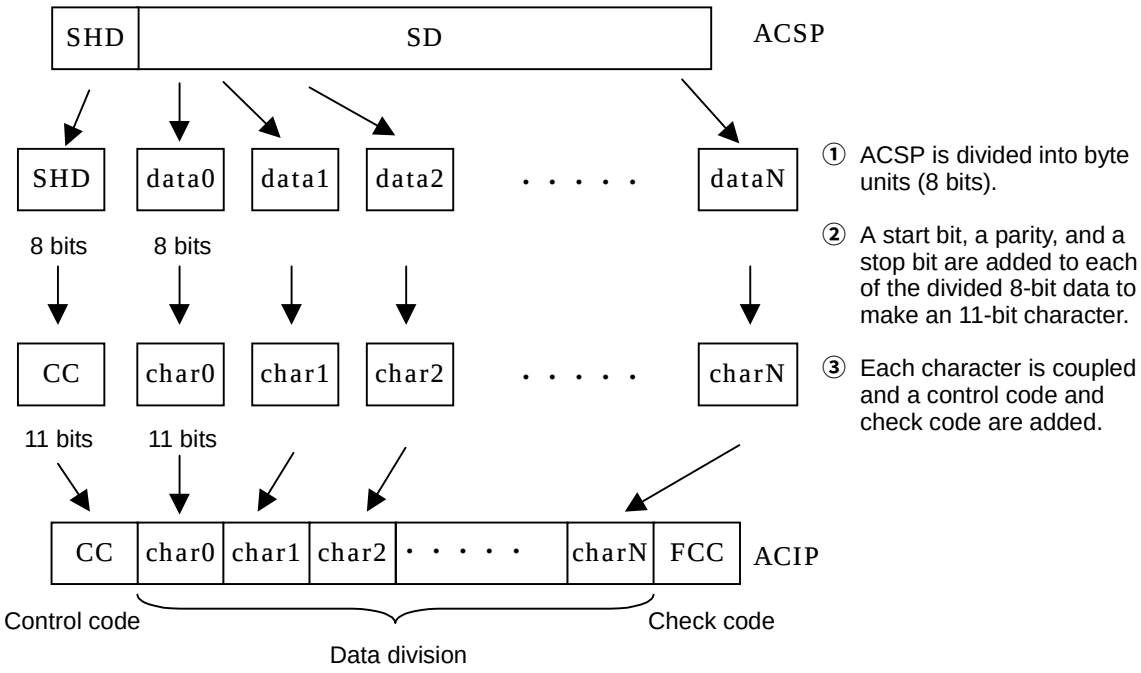



**Fig. 3.22 Translation Processing from ACSP to ACIP**

(2) ACIP to ACSP translation processing

Fig. 3.23 shows the translation processing.

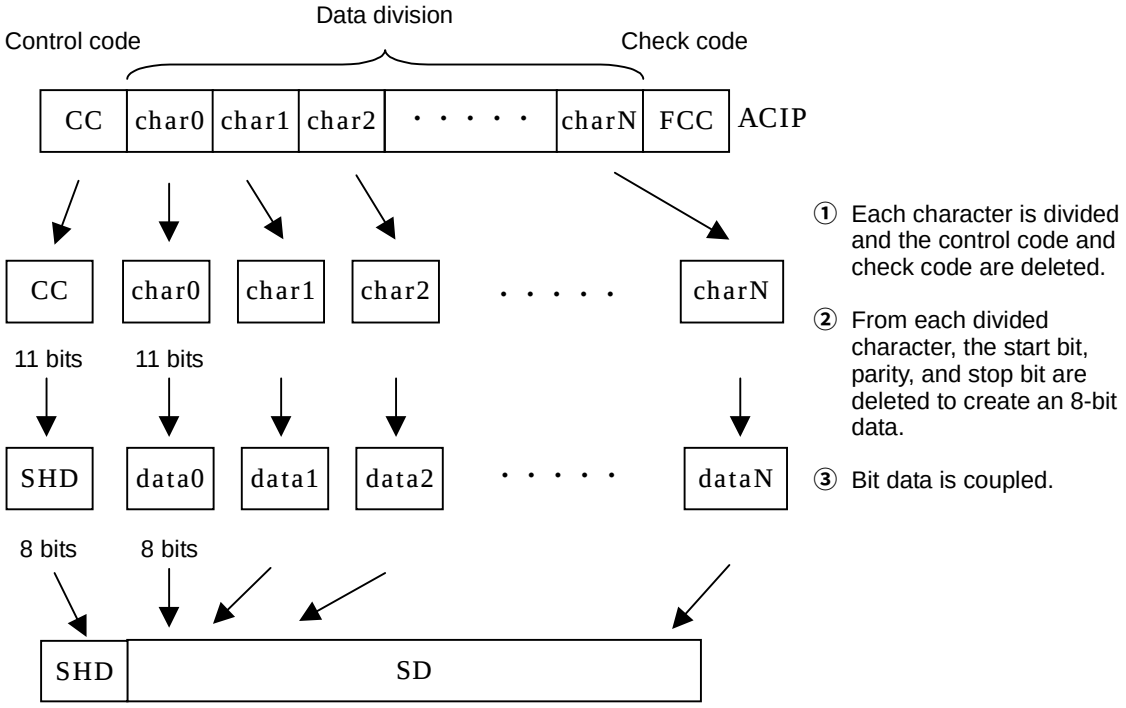



**Fig. 3.23 ACIP to ACSP Translation Processing**

### 3.6.9 Operation sequence

The operation sequence of the Adapter Communication Software depends on the common Lower-Layer Communication Interface processing mounted in the ECHONET communication processing block or the protocol difference absorption processing connected to the Adapter Communication Software through the common Lower-Layer Communication Interface. In the case of a request for data reception, for example, the following processing methods can be considered.

① The ECHONET communication processing block issues a request for data reception to the Protocol Difference Absorption Processing Block (polling processing).

② The Protocol Difference Absorption Processing Block issues a trigger to notify the receipt of data when such data has been received (event processing).

A case in which the ECHONET communication processing block and the Protocol Difference Absorption Processing Block mounting the different methods above are connected. The Adapter Communication Software must take this into consideration. Fig. 3.24 shows an example of the operation sequence for the data reception request service when the ECHONET communication processing block performs event processing and the Protocol Difference Absorption Processing Block performs polling processing.

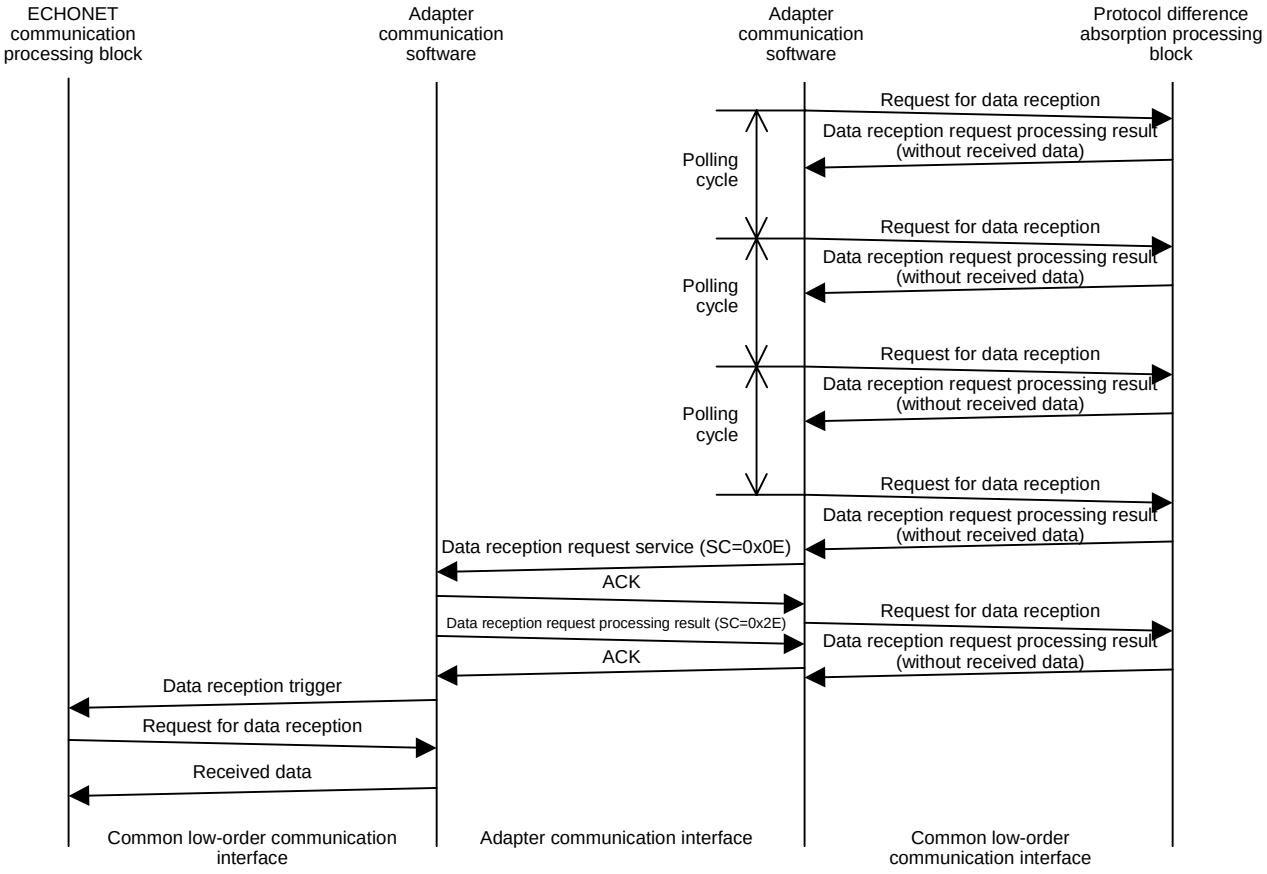



**Fig. 3.24 Adapter Communication Software Sequence**

### 3.6.10 Optional service handling

The common Lower-Layer Communication Interface supports some optional services. Accordingly, in the Adapter Communication Interface, the service processing side may not prepare a service issued by the service requesting side. In this case, the Adapter Communication Interface software on the service processing side must return "Non-processing service notice" (0x3F) as the processing result.

### 3.6.11 Optional data handling

The common Lower-Layer Communication Interface supports some types of optional data. Accordingly, the following two cases may occur in the Adapter Communication Interface.

① The service data processing for the service issued by the service requesting side is not prepared on the service processing side.

② The service data required by the service processing side does not exist in the service issued by the service requesting side.

The Adapter Communication Software must take this into consideration. An outline of the processing to be executed is described below.

<Case ①>

The Adapter Communication Software on the service processing side executes the service of the common Lower-Layer Communication Interface disregarding the non-processable service data.

<Case ②>

The Adapter Communication Software on the service processing side executes the service of the common Lower-Layer Communication Interface after compensating for the lack of service data by the default value.

### 3.6.12 Inhibition of service redundant issue

The Adapter Communication Software can simultaneously issue only one service. That is, the Adapter Communication Software of the service requesting source cannot issue the next service until the corresponding processing response is returned.

### 3.6.13 Timeout

If no processing response is returned after 100 msec (timeout period) has elapsed following the issue of a service request, the next service request can be issued. Fig. 3.25 shows the timeout period.

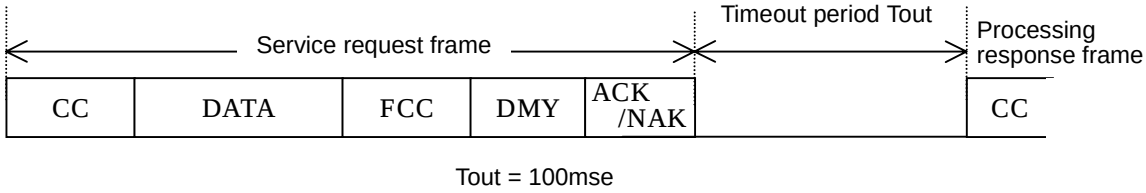



**Fig. 3.25 Timeout Period**

# Chapter 4 ECHONET Gateway

## 4.1 Basic Concept

The application software for connecting an ECHONET domain with an external system using the ECHONET protocol is called a gateway. Devices mounting this gateway are called gateway equipment. In ECHONET, however, processing to be executed by the application is not specified at present. Accordingly, the connection between ECHONET domains and external systems depends on the application software functions. When the system is installed in an ordinary residence, we recommend that users prepare a security function, including a verification function and access control function, for the gateway application to ensure the security of the ECHONET domain. The functional definitions in such a case are described in Part 9.

# Chapter 5 ECHONET Router

## 5.1 Basic Concept

ECHONET permits different types of networks to be connected as one system for operation. The ECHONET router makes the connection between two networks. The ECHONET router is not a TCP/IP router but an ECHONET-dedicated device that can perform ECHONET communication processing. However, the ECHONET router need not always be special equipment that performs only routing; for example, a PC or controller provided with multiple ECHONET communication interfaces may be operated as a router with a routing function. (As another example, an air conditioner may be provided with a function for routing between infrared and a power line. Any device type may be operated as a router with a routing function.) Accordingly, the ECHONET router becomes communication equipment having two or more ECHONET addresses and consists of two or more nodes as necessary. The requirements for the use of IrDA Control as ECHONET Lower-Layer Communication Software are described in Section 6.

## 5.2 Function Definition

The ECHONET router shall be provided with the following minimum conditions and functions:

(1) The ECHONET router is physically connected to two or more subnets. The Lower-Layer Communication Protocols may be the same or different. For each subnet to be connected, MAC addresses and ECHONET addresses must be held and managed. (The ECHONET router consists of two or more nodes.)

(2) The ECHONET communication processing block is provided with a routing function, and the communications definition object is provided with a routing table. This routing function conforms to the routing specifications explained in Part 2.

### 5.2.1 Mechanical and physical characteristics

Regarding the specification of connections with transmission media, the specification in Part 4 shall be observed in accordance with each communication protocol corresponding to the ECHONET router. Other mechanical and physical characteristics for ECHONET routers are specified below.

(1) Shape

Shape shall not be specified except for the wired-type transmission media connection block. The shape of the transmission media connection block shall conform to the specification of the layer communication protocol to be used.

(2) Display block

To display the operation status of the ECHONET router, the following minimum specifications must be satisfied. For display methods using means not specified here, the specification native to the product shall be applicable. Regarding the operation status, see Part 2, Section 5.

- Number of LEDs
  1 LED (for operation status display)

- LED color
  Green

- Status display method

| | |
|---|---|
| Normal operation (NetID acquires) | : ON |
| Normal operation (NetID not acquired) | : Blink (cycle 1) |
| Initial operation | : Blink (cycle 2) |
| Error | : Blink (cycle 3) |
| Non-operation | : OFF |

  * Cycle 1 .....Repetition of ON for 2 sec and OFF for 2 sec
  * Cycle 2 .....Repetition of ON for 2 sec and OFF for 0.5 sec
  * Cycle 3 .....Repetition of ON for 0.5 sec and OFF for 0.5 sec

- Others
  It shall be possible to easily check the LED from the outside without removing the ECHONET router.

Note: Initial processing means a cold start (full reset start) and a warm start (hardware executes reset processing while keeping acquired addresses and initial settings).

### 5.2.2 Electrical characteristics

For transmission media connections, the specifications in Part 3 shall be observed for each Lower-Layer Communication Protocol corresponding to the ECHONET router.

### 5.2.3 Logical specification

For Lower-Layer Communication Protocols, the logical specifications provided in Part 3 are observed for each Lower-Layer Communication Protocol corresponding to the ECHONET router. For the Protocol Difference Absorption Processing Block, the logical specifications provided in Section 7 “Protocol Difference Absorption Processing Block Specification” in Part 2 are observed. For the routing specification, what conforms to the routing specification explained in Part 2 is specified.

# Chapter 6 IrDA Control Router

## 6.1 Basic Concept

In ECHONET, routing processing with a subnet adjacent to subnets consisting of IrDA Controls must satisfy the requirements native to the IrDA Control in addition to the requirements for a general ECHONET router. That is, the functions as the ECHONET router must be implemented on the IrDA Control host. This is intended to absorb restrictions on IrDA Control communication functions when the IrDA Control host functions as a router.

In this Section, only the contents of the specification native to “IrDA Control Router” are described. Accordingly, see Section 5 for contents common to “General Router”.

1) Restrictions

The IrDA Control is designed based on the specification provided for communication between a PC (host) and a peripheral device (peripheral) by infrared, and is not provided with the following functions:

① Communication between peripheral devices (peripherals) (because communications between the mouse and the keyboard are not required)

② Simultaneous broadcast communications

③ Bind start request from the host side (because communications are started with input on a peripheral device)

2) Restriction absorbing method

To compensate for the functions in items ① to ③ above, ECHONET specifies the following functions:

For item ①: Communications between peripheral devices are implemented by the host’s relay of data (as described in Section 6.2 “Communications between Peripherals”).

For item ②: For simultaneous broadcast data, the host transmits data individually (as described in Section 6.3 “Communications of Broadcast-specified Data”).

For item ③: The peripheral side starts binding periodically to solve the problem of item ③ above. It is specified that the host should be provided with a receiving buffer (as described in Section 6.4 “Communication to a Peripheral in Unbind Status”).

## 6.2 Communications between Peripherals

As described in the previous section, the IrDA cannot perform direct communications between peripherals. Communications between peripherals (so-called N:M communication) can be performed by the host's relay of data. This section describes only individual specified data. Broadcast-specified data is described in the next section.

Fig. 6.1 shows a procedure for transmitting data from peripheral A to peripheral B.

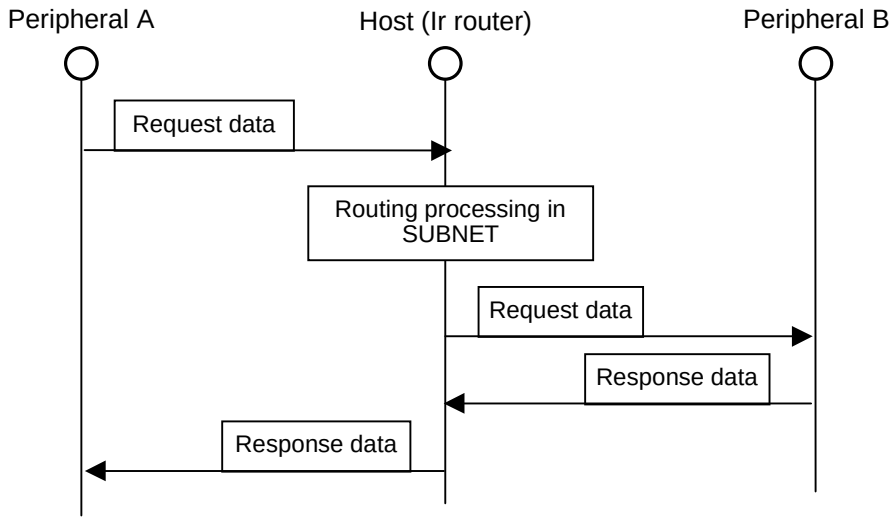



**Fig. 6.1 Communication Sequence between Peripherals**

Thus, peripheral A transmits data to the host. The host that has received data from peripheral A performs routing processing in the subnet and transmits the received data as transmission data to peripheral B. In cases requiring response data as shown in Fig. 6.1, the host can relay data in the same way as it can request data.

Fig. 6.2 shows an outline of processing between layers when peripheral-to-peripheral communication is performed. Characteristic processing for IrDA Control (host routing processing, virtual MAC address, address control table, etc.) is mainly explained as follows:

(Processing in peripheral A of the transmitting source)

① In the ECHONET Communication Middleware of peripheral A, transmission data is created. At this time, specify SEA = self NodeID and DEA = transmitting destination NodeID. (SEA = 0x02, DEA = 0x03 in the case shown in Fig. 6.2)

② The protocol difference absorption layer performs address translation processing. Specify host NodeID (= MAC address) instead of DEA NodeID as the MAC address. Next, the data is delivered to data divide processing and transmit processing. A request for data transmission is sent to the ECHONET Lower-Layer Communication Software.

(Relay processing by the host)

③ The peripheral address (PADD, 4 bits) of the transmitting source is translated into the "virtual MAC address" (8 bits) by referencing the address control table under control of the host.

④ In the Protocol Difference Absorption Processing Block, the "virtual MAC address" of the transmitting source is translated as "NodeID" of the transmitting source.

⑤ In the received data judgment processing block, when both transmitting source NetID and transmitting destination NetID are specified as those of a self-subnet, the data is determined to be intra-subnet communication data, and intra-subnet routing processing is performed. In this case, the number of END hops is not added, and the received data is transferred to address translation processing as transmission data.

⑥ In the address translation processing block, DEA NodeID is extracted and address translation processing is performed. In this case, DEA NodeID and transmitting destination MAC address (virtual MAC address) have a 1:1 association, so no translation is required.

⑦ In the ECHONET Lower-Layer Communication Software, the transmitting destination MAC address (virtual MAC address) is translated into PADD (4 bits) by referencing the address control table. If bind processing has already been performed, said table is translated into PADD by referencing the address control table. If bind processing has not been performed, the transmission data is held in the transmitting buffer. At this time, because the PADD of the transmitting destination peripheral is not available, the virtual MAC address is held.

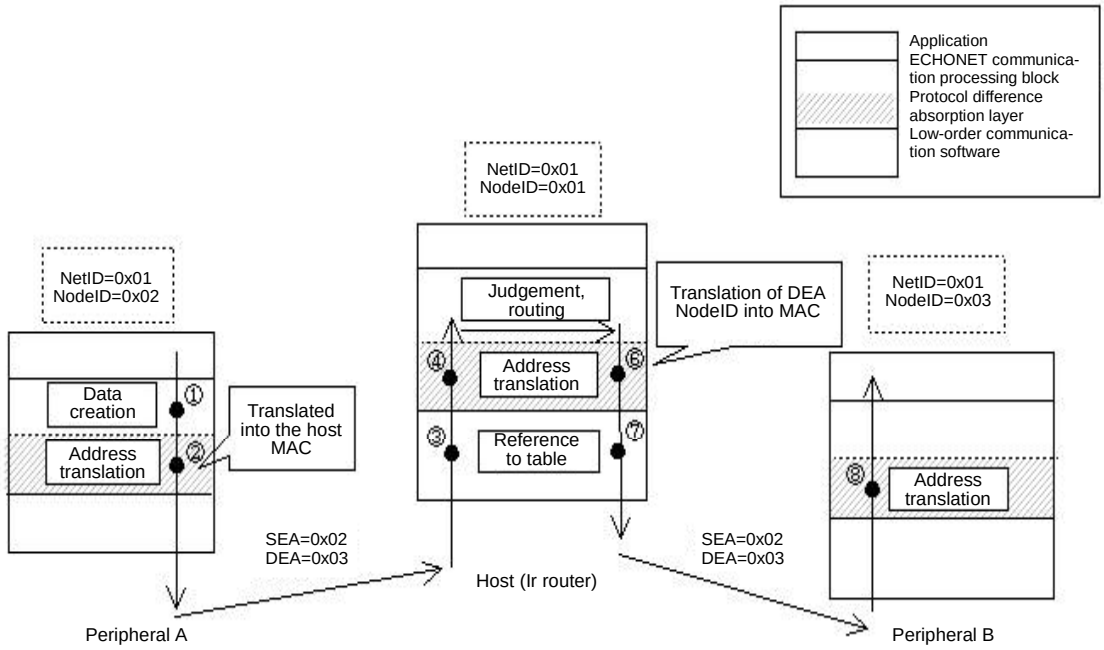



**Fig. 6.2 Outline of In-layer Processing of Transmission Sequence between Peripherals**

## 6.3 Rules of Broadcast-specified Data Communication

### 6.3.1 Overview

The IrDA Control must be provided with a broadcast-specified data function as described in the previous section. When the host receives broadcast-specified data including the self-subnet, it must transmit data individually to peripherals in the subnet. This section describes the processing sequence for when the host receives broadcast data.

The self-subnet broadcast specification is classified into the following two cases:

(1) When receiving broadcast-specified data from outside IrDA subnet.

(2) When receiving broadcast-specified data from inside IrDA subnet.

Each of these cases is described below.

### 6.3.2 When receiving broadcast-specified data from outside IrDA subnet

Fig. 6.3 shows a processing sequence for when broadcast-specified data, including the IrDA Control subnet, is received from outside the IrDA Control subnet. This example explains the case in which broadcast-specified data is transmitted from node X of the adjacent subnet to the IrDA Control subnet. The sequence shown in Fig. 6.3, “Response data (Note) (from host)”, is only for cases in which the host must return a response. When the host receives request data (broadcast) oriented to the IrDA Control subnet, internal processing is as follows:

- In data judgement processing, when the EHD of received data is the broadcast specification, and the destination of the broadcast data includes “self-subnet NetID” by referencing “Broadcast specification type code” and “Broadcast target specification code”, “routing processing” is performed in the same way as the general router.
- In “routing processing”, the EHD hop count is incremented by 1, and the received data is transferred as transmission data to the Protocol Difference Absorption Processing Block through the common Lower-Layer Communication Interface.
- The protocol difference absorption layer transfers the request for transmission received from the predecessor to the ECHONET Lower-Layer Communication Software of the IrDA Control together with broadcast specification information through the discrete Lower-Layer Communication Interface.
- The ECHONET Lower-Layer Communication Software transmits broadcast data individually to transmittable peripherals (see Note 1) other than the transmitting source peripheral. In this case, the MAC address of the peripheral is the information held by the host at bind processing and requires no translation.

Note 1: “Transmittable peripherals” signifies a bind status for the host. Data transmission to peripherals in unbind status is described in Section 6.4.

When transmission to all peripherals is completed or the holding time has elapsed, data in the buffer is abandoned and processing is terminated.

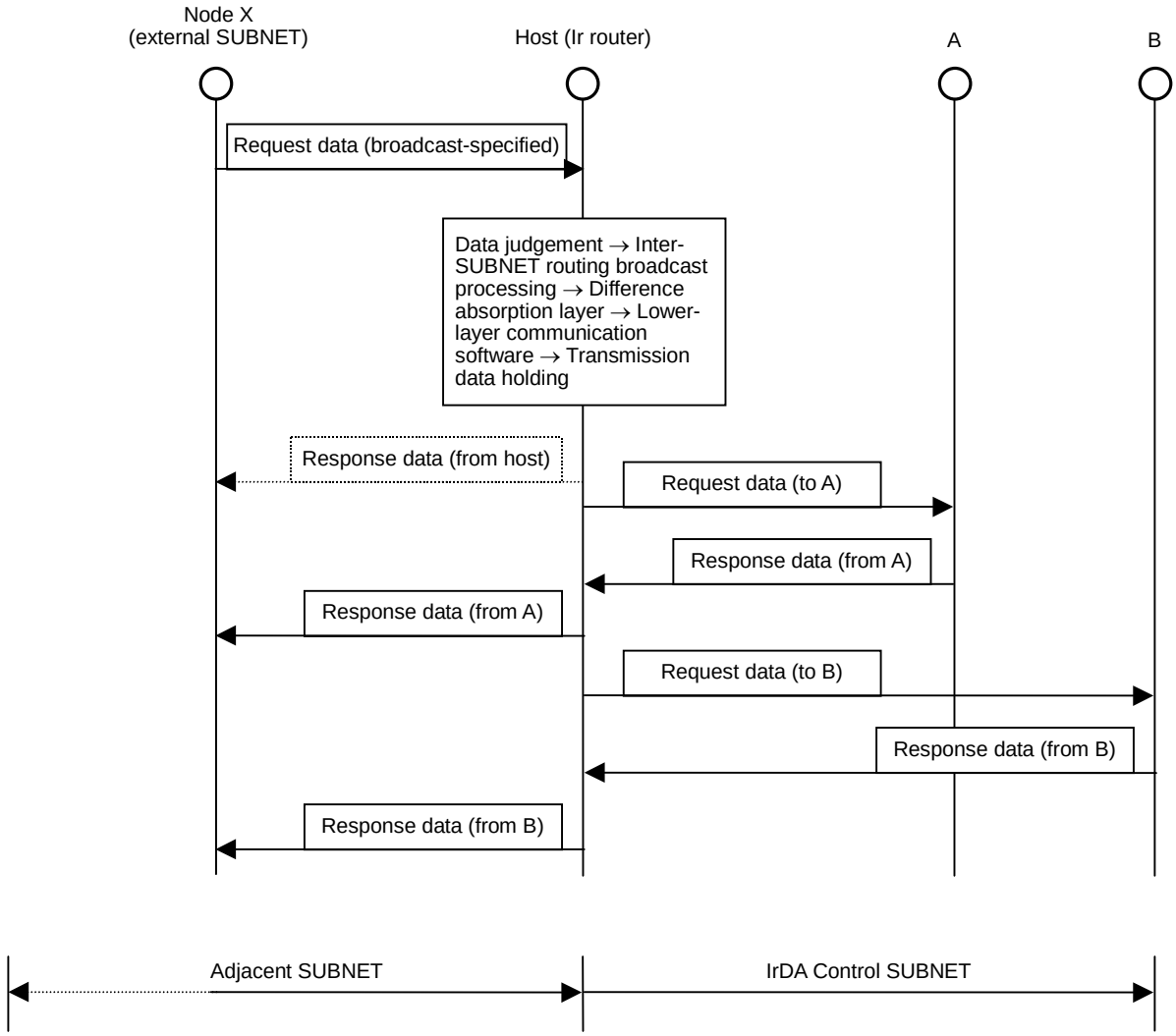



**Fig. 6.3 Broadcast-specified Data Communication Sequence from Outside IrDA Control subnet**

### 6.3.3 When receiving broadcast-specified data from inside IrDA subnet

Fig. 6.4 shows the processing sequence for when broadcast-specified data is received from the self-IrDA Control subnet. When the host receives request data (broadcast) oriented to the IrDA Control subnet, internal processing in the host is performed as follows:

- In data judgement processing, when the EHD of the received data is the broadcast specification, the destination of the broadcast data includes “self-subnet NetID” by referencing “Broadcast specification code” and “Broadcast target specification code”, and the transmitting source NetID matches the self-subnet NetID, “Intra-subnet routing processing” native to the IrDA Control is performed. (However, routing processing to the data transmitting destination node is not performed.)
- In “Intra-subnet routine processing”, the EHD hop count is not incremented, and the received data is transferred as transmission data to the Protocol Difference Absorption Processing Block through the common Lower-Layer Communication Interface.
- The protocol difference absorption layer transfers the request for transmission received from the predecessor to the ECHONET Lower-Layer Communication Software of the IrDA Control together with broadcast specification information through the discrete Lower-Layer Communication Interface.
- The ECHONET Lower-Layer Communication Software transmits broadcast data individually to transmittable peripherals (see Note 1). In this case, the MAC address of the peripheral is the information held by the host at bind processing and requires no translation.

Note 1: “Transmittable peripherals” signifies a bind status for the host. Data transmission to peripherals in the unbind status is described in Section 6.4. When transmission to all peripherals is completed or the holding time has elapsed, data in the buffer is abandoned and processing is terminated.

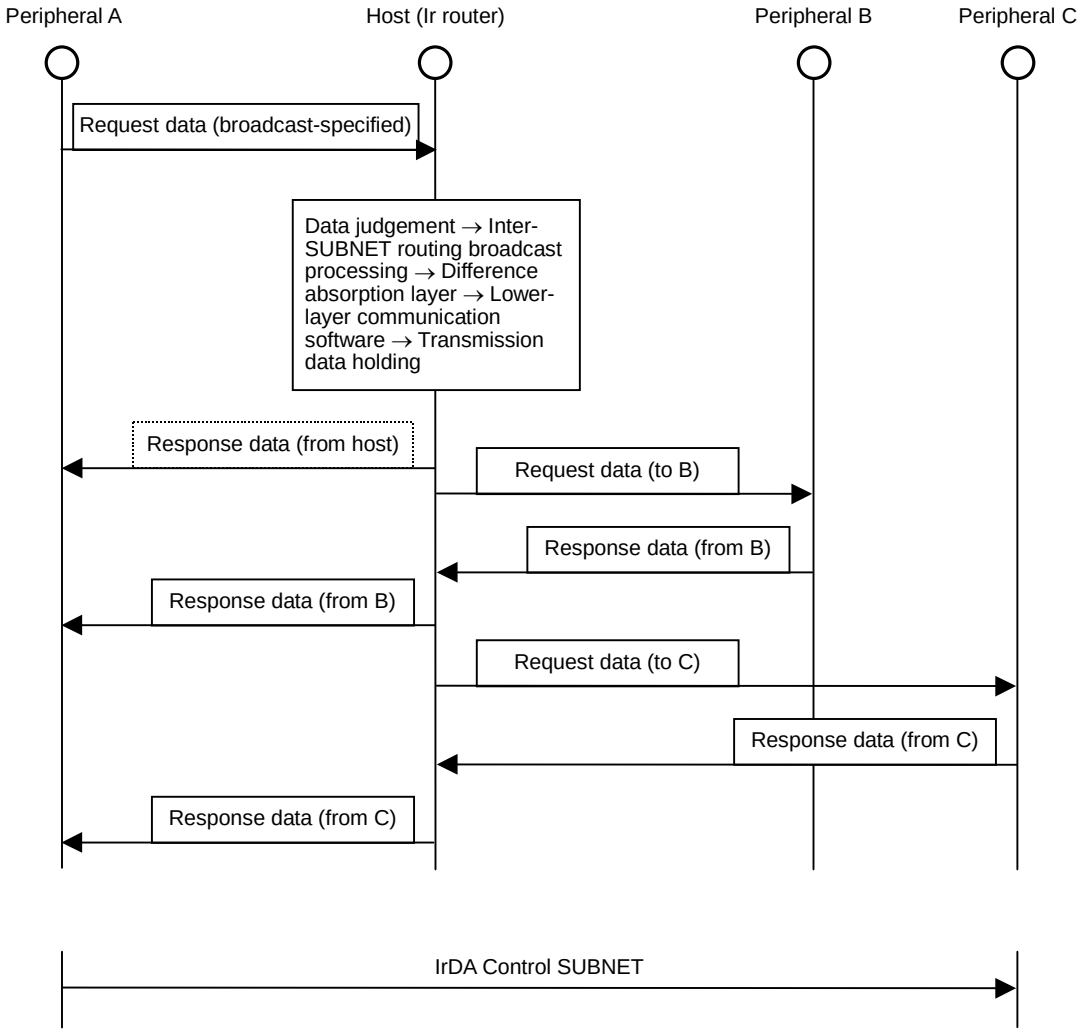



**Fig. 6.4 Broadcast-specified Data Communication Sequence from Inside IrDA Control subnet**

## 6.4 Communication to a Peripheral in the Unbind Status

### 6.4.1 Basic Concept

As described in 1) Restrictions in Section 6.1, the IrDA Control cannot perform a bind start request function from the host side. In this situation, data communication cannot be performed from the host or another subnet in the unbind status (idle status). In ECHONET, a means for compensating for this problem has been adopted in the specification to secure bi-directionality of communication start in pseudo form. Therefore, the ECHONET Lower-Layer Communication Software must be provided with the following functions:

Peripheral-dedicated Lower-Layer Communication Software specification

- It is mandatory to mount a function to make a bind request to the host periodically in accordance with “Bind request interval (*1)” that can be set by an application. However, this interval can be set arbitrarily. An infinite interval shall also be allowed.

Host-dedicated communication software specification

- The host can hold data oriented to the self-subnet received from an external subnet or the self-SIUBNET during the “Data holding time (*2)” set for each peripheral. Mounting of this function shall also be mandatory.

### 6.4.2 Sequence

Fig. 6.5 shows a processing sequence for data from another subnet to a peripheral in the unbind status. The sequence is explained below.

- The host receives data oriented to the self-subnet.
  (Includes both individual and broadcast; data from self-subnet is the same.)
- The host performs data judgement and routing processing as described in the previous section and transfers the request for transmission to the ECHONET Lower-Layer Communication Software.
- If the transmitting destination peripheral is in the unbind status, data is transmitted immediately. If it is in the bind status (including broadcast), data is held in the buffer.
- Each peripheral mounts a fixed-time communication function and makes a bind request to the host at the set interval.
- When receiving a bind request from the peripheral, the host starts bind processing for the peripheral.
- Data is transmitted to a peripheral in the bind status. If a response is required, the response is returned.

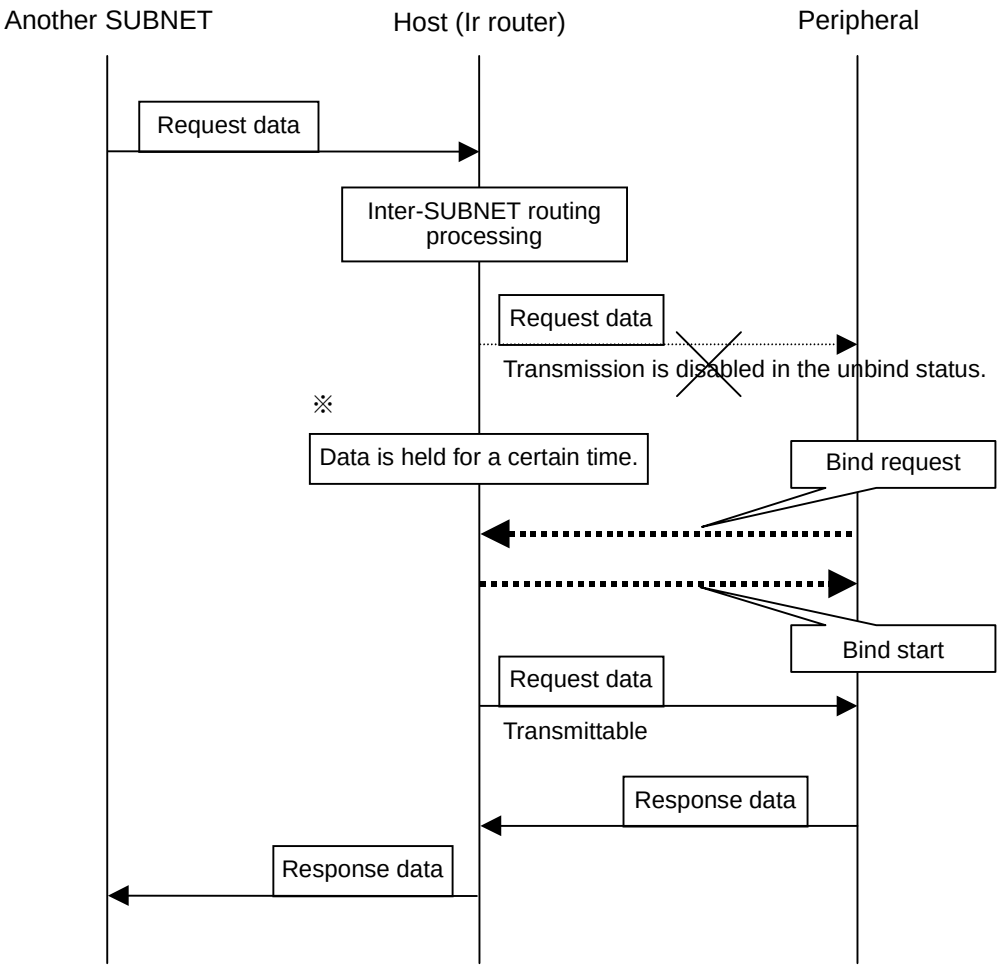



**Fig. 6.5 Communication Sequence to a Peripheral in the Unbind Status**

“Bind Interval (*1)”

The ECHONET standard does not specify any “Bind interval (*1)” setting. However, the following point must be considered in system design.

The IrDA Control Specification specifies that current status switches to unbind status if non-communication status continues for 5 or 30 seconds between the host and a peripheral. (This value can be set to five or thirty seconds.) Accordingly, to keep the bind status at all times in ECHONET, the transition time to the unbind status must be set to “30 sec” and “Bind interval (*1)” must be set to 30 sec or less. Usually, this setting is desirable when constructing a system.

When the main purpose of an application is to notify the central monitoring equipment of the occurrence of an event by using a body sensor when a peripheral is driven by a battery, “Bind interval (*1)” should be set to “Infinite”, thereby minimizing battery power consumption and extending battery life.

When setting “Data holding time (*2)”, the following two issues should be considered from the viewpoint of system design and operation:

1. When “Bind interval (*1)” is set so as not to switch to the unbind status
   The host can transmit received data to the corresponding peripheral immediately, so the data holding time may be set to several seconds.
2. When “Bind interval (*1)” is set so as to switch to the unbind status
   “Data holding time (*2)” must be set to a longer value than “Bind interval (*1)”, or the host will not be able to transmit received data to the corresponding peripheral.