

Interface Specification

for Application Layer

Communication between Smart

Electric Energy Meters and

HEMS Controllers

Version 1.00



Revision record

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Chapter 1. Introduction

This document specifies matters necessary for ensuring interoperability between the products of different manufacturers in connection with application layer communication between smart electric energy meters and HEMS controllers, using ECHONET Lite as an application protocol via UDP/IPv6 communications.

In this specification, the connection configuration between smart electric energy meters and HEMS controllers shall be limited to a one-to-one communication as shown in Fig. 1- 1 .

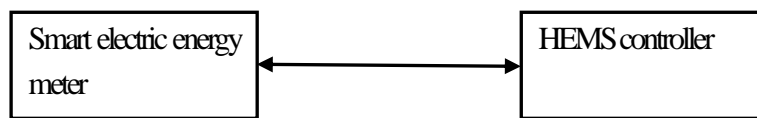
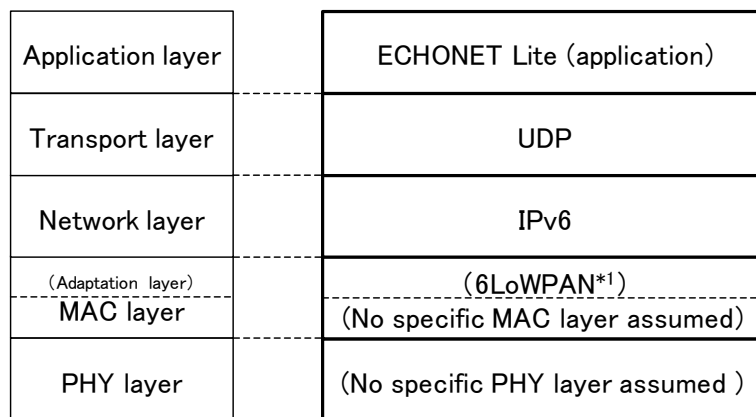


Fig. 1-1 Connection configuration

Fig. 1- 2 shows the assumed network stack for operating ECHONET Lite in this document. ECHONET Lite will be operated as an application protocol via UDP/IPv6.



*1) Depends on transmission media

Fig. 1-2 Assumed network stack

Lower Layer Connection processing specific to each communication medium necessary before the start of ECHONET Lite communication is outside the scope of this document. In this document, application communication using ECHONET Lite will be described on the assumption that connection processing specific to those communication media is complete.

1.1. Definitions

HEMS controller	A node that communicates with a smart electric energy meter in ECHONET Lite using IPv6
Smart electric energy meter	A node that communicates with a HEMS controller and provides various electric power data in ECHONET Lite using IPv6

1.2. Reference Standards

Standards referenced in this document are as stated below. Matters not specifically explained in this document shall be as described in each document.

- [EL] ECHONET Lite Specification Version 1.01, 1.10
- [ELOBJ] ECHONET Specification APPENDIX: Detailed Requirements for ECHONET Device Objects, Release D

Chapter 2. Application Layer

ECHONET Lite [EL] will be adopted in an application layer. Nodes based on the descriptions in this document must support all mandatory functions specified in [EL].

2.1. ECHONET Objects (EOJ)

ECHONET objects (EOJ) installed in smart electric energy meters and HEMS controllers shall be as shown in Table 2-1.

Table 2-1 ECHONET objects (EOJ)

	Group code	Class code	Class name	Instance code*
Smart electric energy meter	0x02	0x88	Smart electric energy meter	0x01
	0x0E	0xF0	Node profile	0x01
HEMS controller	0x05	0xFF	Controller	0x01
	0x0E	0xF0	Node profile	0x01

*The instance code shall be fixed at 0x01.

2.2. ECHONET Lite Services (ESV)

Smart electric energy meters and HEMS controllers shall support the ECHONET Lite service codes (ESV) shown in Table 2- 2 .

Table 2-2 ECHONET Lite service codes (ESV)

Service code (ESV)	ECHONET Lite service content	Symbol
0x51	Property value write request “response not possible”	SetC_SNA
0x52	Property value read “response not possible”	Get_SNA
0x61	Property value write request (response required)	SetC
0x62	Property value read request	Get
0x71	Property value write response	Set_Res
0x72	Property value read response	Get_Res
0x73	Property value notification	INF
0x74	Property value notification (response required)	INFC
0x7A	Property value notification response	INFC_Res

2.3. Object-Specific ECHONET Properties (EPC)

Smart electric energy meters shall install the ECHONET properties (EPC) of device objects shown in Table 2- 3 and Table 2- 4 . ECHONET properties (EPC) of node profile objects shall only support mandatory properties.

Table 2-3 Device objects (super class requirements)

Property name	EPC	Access rule		Announcement at status change	Remarks
		Get	Set		
Installation location	0x81	◎	◎	◎	
Standard version information	0x82	◎	—	—	
Fault status	0x88	◎	—	◎	
Manufacturer code	0x8A	◎	—	—	
Serial No.	0x8D	○	—	—	To make it easier to judge whether a meter should be replaced due to malfunction or inspection expiry, it is recommended that this number be unique to each device in corresponding to the manufacturer code.
Current time setting	0x97	◎	●	—	
Current date setting	0x98	◎	●	—	
Status change announcement property map	0x9D	◎	—	—	
Set property map	0x9E	◎	—	—	
Get property map	0x9F	◎	—	—	

◎: mandatory, ○: optional, —: not supported, ●: installation prohibited

Table 2-4 Device objects (smart electric energy meter class requirements)

Property name	EPC	Access rule		Announcement at status change	Remarks
		Get	Set		
Operation status	0x80	◎	—	◎	
Composite transformation ratio	0xD3	○	—	—	In the case of meters with transformers, the actual power

					consumption value shall be calculated by multiplying the cumulative amounts of electric energy by the composite transformation ratio.
Multiplying factor for composite transformation ratio	0xD4	—	—	—	When properties are not installed, the multiplying factor shall be treated as 1.
Number of effective digits for cumulative amount of electric energy	0xD7	⊙	—	—	
Measured cumulative amount of electric energy (normal direction)	0xE0	⊙	—	—	
Unit for cumulative amounts of electric energy (normal and reverse directions)	0xE1	⊙	—	—	
Historical data of measured cumulative amounts of electric energy 1 (normal direction)	0xE2	⊙	—	—	
Measured cumulative amounts of electric energy (reverse direction)	0xE3	○	—	—	Mandatory if there is a reverse direction measurement function
Historical data of measured cumulative amounts of electric energy 1 (reverse direction)	0xE4	○	—	—	Mandatory if there is a reverse direction measurement function
Day for which the historical data of measured cumulative amounts of electric energy is to be retrieved 1	0xE5	⊙	⊙	—	
Measured instantaneous electric energy	0xE7	⊙	—	—	
Measured instantaneous currents	0xE8	⊙	—	—	
Cumulative amounts of electric energy measured at fixed time (normal direction)	0xEA	⊙	—	—	
Cumulative amounts of electric energy measured at fixed time (reverse direction)	0xEB	○	—	—	Mandatory if there is a reverse direction measurement function
Historical data of	0xEC	○	—	—	

measured cumulative amounts of electric energy 2 (normal and reverse directions)					
Day for which the historical data of measured cumulative amounts of electric energy is to be retrieved 2	0xED	○	○	—	

◎: mandatory, ○: optional, —: not supported

2.4. Application Operation

2.4.1. Successive Requests

Smart electric energy meters and HEMS controllers shall operate on the basis of request and response sets; one request sent receives one response in return. When making successive requests, the next request is made after receiving the response to the previous request, or after a response timeout.

This document shall set out requirements for one-to-one communication, and show cases in which successive requests are those made from the same device.

2.4.2. Response Wait Timer

The response wait timer values of a HEMS controller when a smart electric energy meter is responding to a request from it shall be based on Table 2- 5 .

Table 2- 5 Response wait timer values of HEMS controllers

Parameter name	Value	Remarks
Response wait timer 1	At least 20 [sec]	When the OPC value is 1, except when the EPC is as shown below. <ul style="list-style-type: none"> • EPC=0xE2 Historical data of measured cumulative amounts of electric energy 1 (normal direction) • EPC=0xE4 Historical data of measured cumulative amounts of electric energy 1 (reverse direction) • EPC=0xEC Historical data of measured cumulative amounts of electric energy 2 (normal and reverse directions)
Response wait timer 2	At least 60 [sec]	When the OPC value is 2 or more, or when the EPC is as shown below.

		<ul style="list-style-type: none"> • EPC=0xE2 Historical data of measured cumulative amounts of electric energy 1 (normal direction) • EPC=0xE4 Historical data of measured cumulative amounts of electric energy 1 (reverse direction) • EPC=0xEC Historical data of measured cumulative amounts of electric energy 2 (normal and reverse directions)
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The response wait timer values of a smart electric energy meter when an HEMS controller is responding to a request from it shall be based on Table 2- 6 .

Table 2-6 Response wait timer values of smart electric energy meters

Parameter name	Value	Remarks
Response wait timer 1	At least 20 [sec]	

2.4.3. Retransmission Processing

When smart electric energy meters and HEMS controllers are subject to a timeout at application (ECHONET Lite) level, data shall not be retransmitted within the frame of the same transaction ID (TID).

2.4.4. Processing Target Property Counter (OPC) Value

Smart electric energy meters must be capable of supporting OPC value 6 or more and HEMS controllers OPC value 2 or more. However, when using the EPC for historical data of measured cumulative amounts of electric energy described in 3.3.2 and 3.3.3, smart electric energy meters need not support multiple OPCs.

Response to requests with more than one OPC value is given in the sequence of processing properties designated by EPC when the request was made.

2.4.5. Property Value Set Request

When a HEMS controller makes a SetC[0x61] request, a value outside the range of properties required by [ELOBJ] must not be set.

When a smart electric energy meter receives a SetC[0x61] request from a HEMS controller, a response shall be given with Set_Res[0x71] after the settings have been completely set. When the settings are outside the range and cannot be set, the response shall be SetC_SNA[0x51].

Therefore, when a HEMS controller receives Set_Res[0x71], set confirmation via Get[0x62] is not necessary.

2.5. Others

2.5.1. Treatment of Data Duplication

If a HEMS controller receives duplicated measurements of cumulative amounts of electric energy at fixed time (30-minute value) from a smart electric energy meter at the same measurement time, the data arriving last shall be taken as correct.

Chapter 3. Standard Operation

In this Chapter, the standard operation between smart electric energy meters and HEMS controllers will be shown. Smart electric energy meters and HEMS controllers produced on the basis of this document must support the operation described in this Chapter.

Fig. 3- 1 illustrates a sequence of standard operations between a smart electric energy meter and a HEMS controller. Here, it shall be assumed that network connection processing in the lower layer between smart electric energy meters and HEMS controllers has been completed.

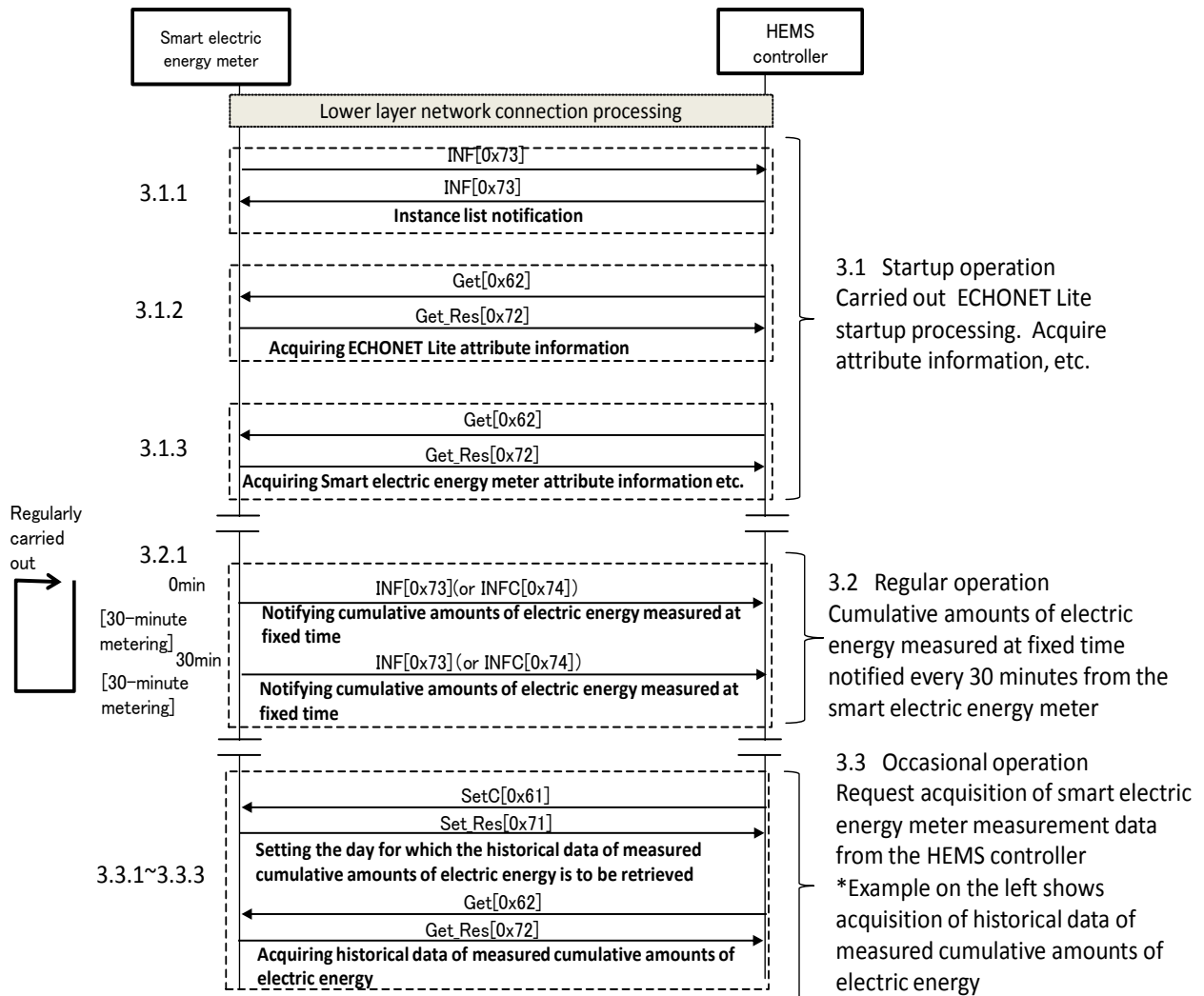


Fig. 3- 1 Example of standard operating sequence

3.1. Startup Operation

3.1.1. ECHONET Lite Node Startup Processing

After completing connection of lower layer network, the smart electric energy meter and the HEMS controller notify an instance list.

- (1) Target properties (node profile objects)
 - 0xD5: Instance list notification

3.1.2. Acquiring ECHONET Lite Attribute Information

After receiving instance list notification from the smart electric energy meter, the HEMS controller requests ECHONET Lite attribute information necessary for ECHONET Lite communication.

It is recommended that the HEMS controller confirms the Appendix Release No. and properties mounted with the smart electric energy meter based on the ECHONET Lite attribute information, and makes requests in line with the mounting status of the smart electric energy meter.

- (1) Target properties (smart electric energy meter objects)
 - 0x82: Standard version information
 - 0x9D: Status change announcement property map
 - 0x9E: Set property map
 - 0x9F: Get property map

- (2) Sequence

Fig. 3-2 shows an example of the sequence for acquiring ECHONET Lite attribute information.

1. After receiving instance list notification from the smart electric energy meter, the HEMS controller requests target properties (combination and sequence may be arbitrary) via Get[0x62].
2. The smart electric energy meter transmits the relevant property value via Get_Res[0x72].

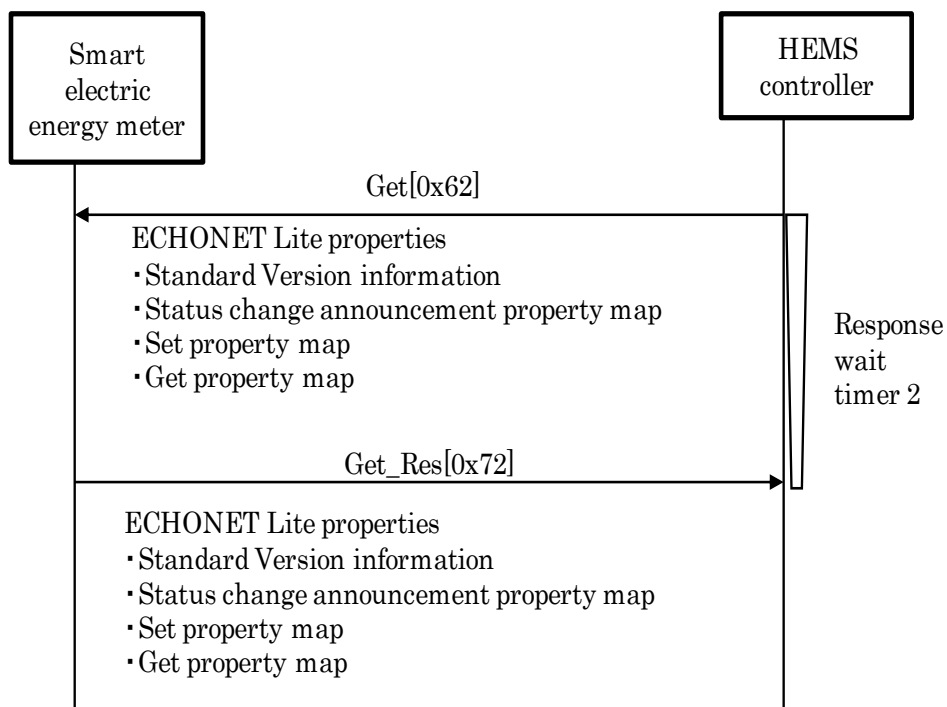


Fig. 3-2 Example of sequence for acquiring ECHONET Lite attribute information

3.1.3. Acquiring Smart Electric Energy Meter Attribute Information, etc.

After acquiring ECHONET Lite attribute information from the smart electric energy meter, the HEMS controller requests attribute information, etc., from the smart electric energy meter. The attribute information, etc., of the smart electric energy meter may be re-acquired if necessary.

- (1) Target properties (smart electric energy meter objects)
 - 0x8D: Serial number [optional property]
 - 0xD3: Composite transformation ratio [optional property]
 - 0xD7: Number of effective digits for cumulative amounts of electric energy
 - 0xE1: Unit for cumulative amounts of electric energy (normal and reverse directions)
 - 0xEA: Cumulative amounts of electric energy measured at fixed time (normal direction)
 - 0xEB: Cumulative amounts of electric energy measured at fixed time (reverse direction) [if there is a reverse direction measurement function]
- (2) Sequence

Fig. 3-3 shows an example of the sequence for acquiring smart electric energy meter attribute information, etc.

1. After acquiring ECHONET Lite attribute information from the smart electric energy meter, the HEMS controller requests target properties (combination and sequence may be arbitrary) via Get[0x62].
2. The smart electric energy meters transmit the relevant property value via Get_Res[0x72]. If an unmounted optional property is requested, the relevant property is transmitted via Get_SNA[0x52].

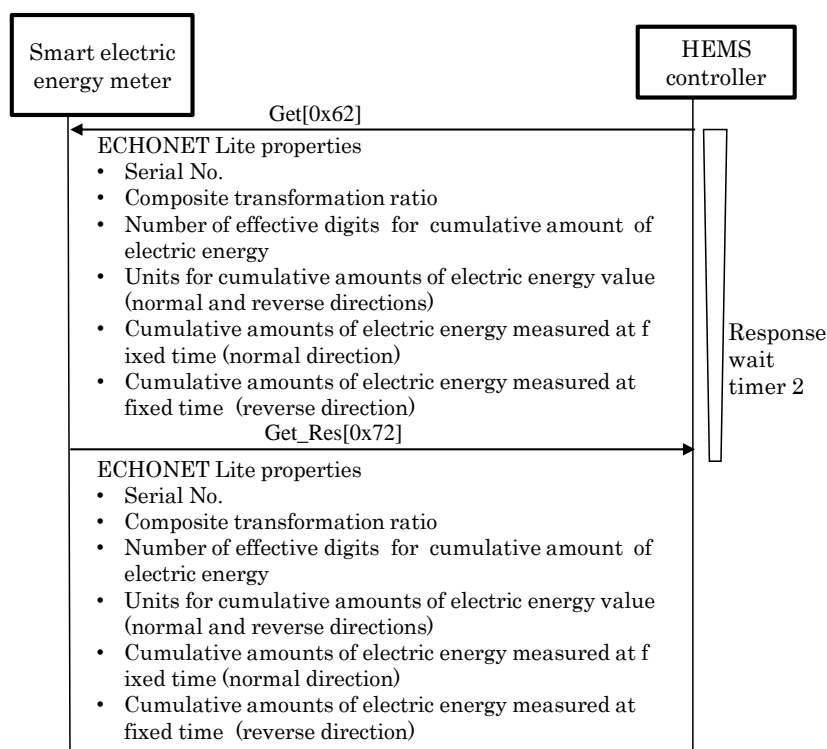


Fig. 3-3 Example of sequence for acquiring smart electric energy meter attribute information, etc.

3.2. Regular Operation

3.2.1. Notifying Cumulative Amounts of Electric Energy Measured at Fixed Time (30-Minute Value)

The smart electric energy meter notifies the latest cumulative amounts of electric energy measured at fixed time (30-minute value) to the HEMS controller within 5 minutes of 00 minutes and 30 minutes after every hour.

- (1) Target properties (smart electric energy meter objects)
 0xEA: Cumulative amounts of electric energy measured at fixed time (normal direction)

0xEB: Cumulative amounts of electric energy measured at fixed time (reverse direction)
 [if there is a reverse direction measurement function]

(2) Sequence

Fig. 3-4 shows an example of the sequence for notification of cumulative amounts of electric energy measured at fixed time (30-minute value).

1. The smart electric energy meter notifies target properties (combination and sequence may be arbitrary) to the HEMS controller individually via INF[0x73] or INFC[0x74] within 5 minutes of 00 minutes and 30 minutes after every hour.
2. If the HEMS controller receives INFC[0x74], it transmits INFC_Res[0x7A] to the smart electric energy meter.

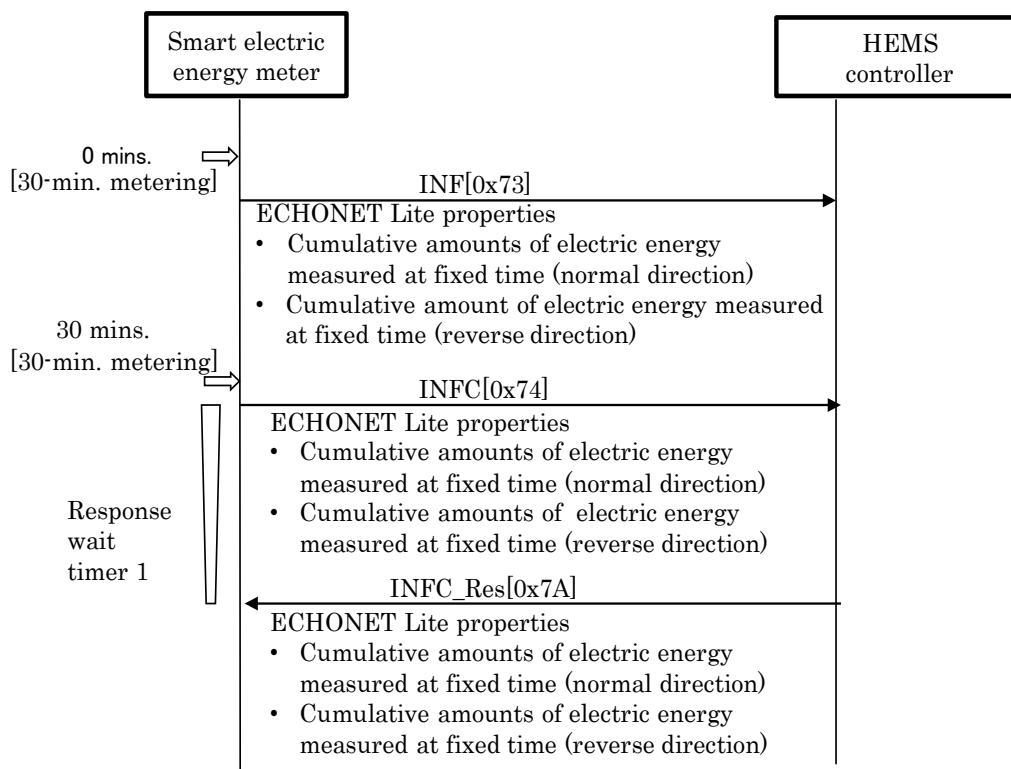


Fig. 3-4 Example of sequence for notifying cumulative amounts of electric energy measured at fixed time (30-minute value)

3.3. Occasional Operation

3.3.1. Acquiring Cumulative Amounts of Electric Energy Measured at Fixed

Time (30-Minute Value)

If necessary, the HEMS controller makes a request to the smart electric energy meter for cumulative amounts of electric energy measured at fixed time (30-minute value). Normally, this is notified from the smart electric energy meter within 5 minutes of 00 minutes and 30 minutes after every hour as shown in 3.2.1 Therefore, this is used as a backup function in case data cannot be received due to temporary communication breakdown, etc.

- (1) Target properties (smart electric energy meter objects)
 - 0xEA: Cumulative amounts of electric energy measured at fixed time (normal direction)
 - 0xEB: Cumulative amounts of electric energy measured at fixed time (reverse direction) [if there is a reverse direction measurement function]

- (2) Sequence

Fig. 3- 5 shows an example of the sequence for acquiring cumulative amounts of electric energy measured at fixed time (30-minute value).

1. If the HEMS controller is unable to receive cumulative amounts of electric energy measured at fixed time (30-minute value), it requests necessary data such as “cumulative amounts of electric energy measured at fixed time (normal direction)” via Get[0x62], targeting at 05 minutes and 35 minutes after every hour or later.
2. The smart electric energy meter transmits the relevant property value via Get_Res [0x72]. If the normal value cannot be responded owing to a fault, Get_SNA[0x52] is transmitted.

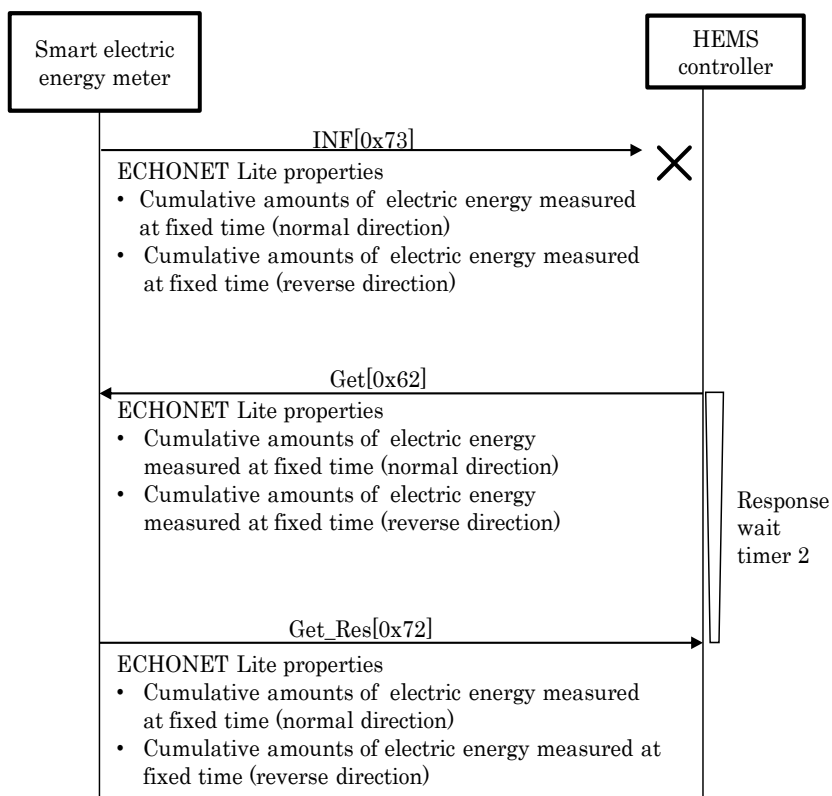


Fig.3-5 Example of sequence for acquiring cumulative amounts of electric energy measured at fixed times (30-minute value)

3.3.2. Acquiring Historical Data of Measured Cumulative Amounts of Electric Energy (1-Day Basis)

If necessary, the HEMS controller requests the historical data of measured cumulative amounts of electric energy (1-day basis, normal direction or reverse direction). If the historical data of measured cumulative amounts of electric energy needed by the HEMS controller corresponds to less than or equal to 6 hours, it can make effective use of the communication bandwidth by using the optional operation to acquire the historical data of measured cumulative amounts of electric energy (maximum 6 hours) described in 3.3.3.

- (1) Target properties (smart electric energy meter objects)
 - 0xE5: Day for which the historical data of measured cumulative amounts of electric energy is to be retrieved 1
 - 0xE2: Historical data of measured cumulative amounts of electric energy 1 (normal direction)
 - 0xE4: Historical data of measured cumulative amounts of electric energy 1 (reverse direction)

(2) Sequence

Fig. 3- 6 shows an example of the sequence for acquiring historical data of measured cumulative amounts of electric energy (1-day basis).

1. If the HEMS controller needs the historical data of measured cumulative amounts of electric energy, it sets the days needed in “Day for which the historical data of measured cumulative amounts of electric energy is to be retrieved 1” and makes a request via SetC[0x61].
2. After completing the set of settings (EDT) designated by SetC[0x61], the smart electric energy meter responds with Set_Res[0x71]. If the designated settings (EDT) cannot be set because they are outside the range of the properties, etc., it responds with SetC_SNA[0x51].
3. After confirming receipt of Set_Res[0x71], the HEMS controller requests either “Historical data of measured cumulative amounts of electric energy 1 (normal direction)” or “Historical data of measured cumulative amounts of electric energy 1 (reverse direction)” via Get[0x62].
4. The smart electric energy meter transmits the relevant property value via Get_Res[0x72]. When it does not have the measured cumulative amounts of electric energy for the time in question, the data will be void, and the value will be given as 0xFFFFFFFF. If the normal value cannot be responded owing to a fault, Get_SNA[0x52] is transmitted.
5. If the HEMS controller requests other historical data of measured cumulative amounts of electric energy, it requests either “Historical data of measured cumulative amounts of electric energy v1 (reverse direction)” or “Historical data of measured cumulative amounts of electric energy 1 (normal direction)” via Get[0x62].
6. The smart electric energy meter transmits the relevant property value via Get_Res[0x72]. When it does not have the measured cumulative amounts of electric energy for the time in question, the data will be void, and the value will be given as 0xFFFFFFFF. If the normal value cannot be responded owing to a fault, Get_SNA[0x52] is transmitted.

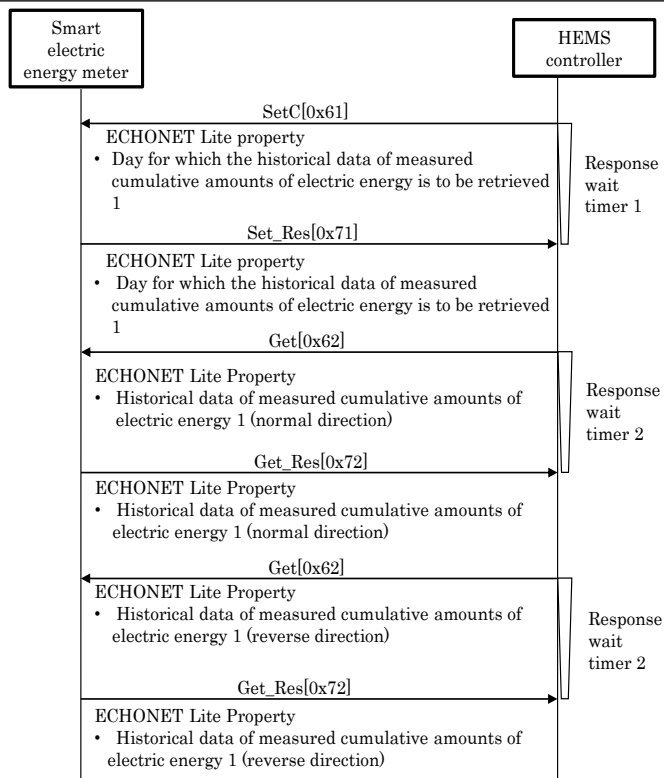


Fig. 3-6 Example of sequence for acquiring historical data of measured cumulative amounts of electric energy (1-day basis)

3.3.3. Acquiring Historical Data of Measured Cumulative Amounts of Electric Energy (Max. 6 Hours) [Optional]

If necessary, the HEMS controller requests historical data of measured cumulative amounts of electric energy (max. 6 hours, normal and reverse directions). If the smart electric energy meter is mounted with target properties, it is recommended that this function be used when acquiring historical data of measured cumulative amounts of electric energy corresponding to less than 6 hours, in order to make effective use of the communication band.

- (1) Target properties (smart electric energy meter objects)
 - 0xED: Day for which the historical data of measured cumulative amounts of electric energy is to be retrieved 2
 - 0xEC: Historical data of measured cumulative amounts of electric energy 2 (normal and reverse directions)

- (2) Sequence

Fig. 3-7 shows an example of the sequence for acquiring historical data of measured

cumulative amounts of electric energy (max. 6 hours).

1. If the HEMS controller needs the historical data of measured cumulative amounts of electric energy, it sets the time needed in “Day for which the historical data of measured cumulative amounts of electric energy is to be retrieved 2” and makes a request via SetC[0x61].
2. After completing the set of the settings (EDT) designated by SetC[0x61], the smart electric energy meter responds with Set_Res[0x71]. If the designated settings (EDT) cannot be set because they are outside the range of the properties, etc., it responds with SetC_SNA[0x51].
3. After confirming the receipt of Set_Res[0x71], the HEMS controller requests “Historical data of measured cumulative amounts of electric energy 2 (normal and reverse directions)” via Get[0x62].
4. The smart electric energy meter transmits the relevant property value via Get_Res[0x72]. When it does not have the cumulative amounts of electric energy for the time in question, the data will be void, and the value will be given as 0xFFFFFFFFE. If the normal value cannot be responded owing to a fault, Get_SNA[0x52] is transmitted.

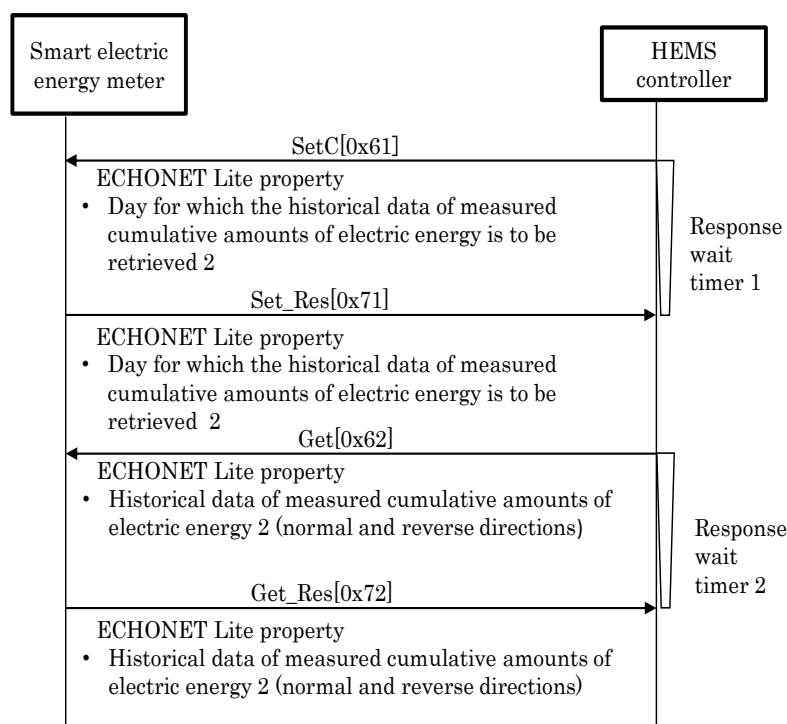


Fig.3-7 Example of sequence for acquiring historical data of measured cumulative amounts of electric energy (max. 6 hours)

3.4. Operation during a Fault

3.4.1. Fault Status Notification

If the smart electric energy meter succumbs to a fault status making it unable to transmit the cumulative amounts of electric energy measured at fixed time (30-minute value), etc., it notifies the fault status (“Fault occurred”) to the HEMS controller. When it has recovered from the fault, it notifies the fault status (“No fault has occurred”) to the HEMS controller.

During the fault, the smart electric energy meter does not notify the cumulative amounts of electric energy measured at fixed time (30-minute value) described in 3.2.1. Operation of the HEMS controller is not required while the smart electric energy meter is in fault status.

- (1) Target properties (smart electric energy meter objects)
0x88: Fault status