Date: Sep. 30, 2014
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Interface Specification for Application Layer Communication between
High-Voltage Smart Electric Energy Meters and EMS Controllers

Interface Specification

for Application Layer Communication

between High-Voltage Smart Electric Energy

Meters and EMS Controllers

Version 1.00

Date: Sep. 30, 2014
Version 1.00
CONFIDENTIAL
ECHONET CONSORTIUM

Interface Specification for Application Layer Communication between
High-Voltage Smart Electric Energy Meters and EMS Controllers

Revision record

Date	Version	Explanation
Aug. 28, 2014	Ver.1.00 Draft	
Sep. 30, 2014	Ver.1.00	・(Chapter 1) IPv6 is changed to "mandatory" and IPv4 to "optional". ・(2.2) (3.2.1) Of the ESV, 0x74 and 0x7A are deleted from the ESV used.

Date: Sep. 30, 2014
Version 1.00
CONFIDENTIAL
ECHONET CONSORTIUM

Interface Specification for Application Layer Communication between
High-Voltage Smart Electric Energy Meters and EMS Controllers

CONTENTS

Date: Sep. 30, 2014
Version 1.00
CONFIDENTIAL
ECHONET CONSORTIUM

Interface Specification for Application Layer Communication between
High-Voltage Smart Electric Energy Meters and EMS Controllers

FIGURES

Date: Sep. 30, 2014
Version 1.00
CONFIDENTIAL
ECHONET CONSORTIUM

Interface Specification for Application Layer Communication between
High-Voltage Smart Electric Energy Meters and EMS Controllers

TABLES

Interface Specification for Application Layer Communication between
High-Voltage Smart Electric Energy Meters and EMS Controllers
1. Introduction

Date: Sep. 30, 2014
Version 1.00
CONFIDENTIAL
ECHONET CONSORTIUM

Chapter 1 Introduction

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

This specification covers high-voltage smart electric energy meters installed for customers supplied with power of 6.6kV. Low-voltage smart electric energy meters installed for customers supplied with 400V or less shall comply with "Interface Specification for Application Layer Communication between Low-Voltage Smart Electric Energy Meters and HEMS Controllers."
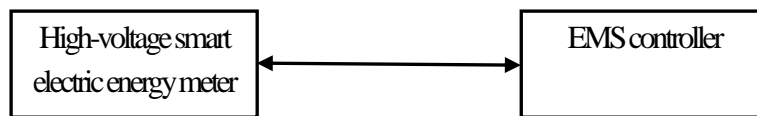
Fig. 1-1 Connection configuration

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.
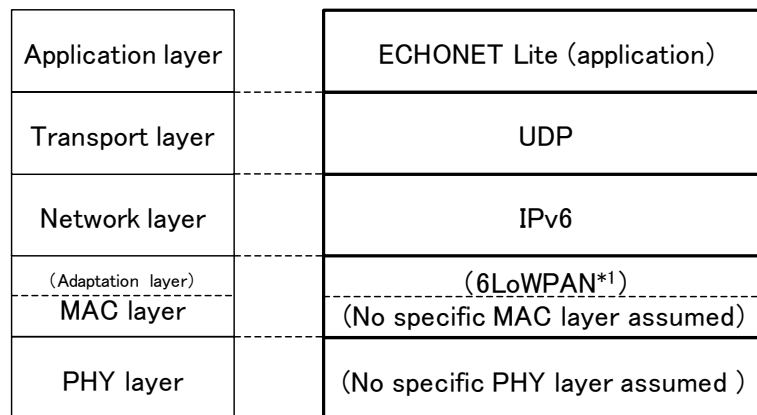
*1) Depends on transmission media

Fig. 1-2 Assumed network stack

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. Basically, it is assumed that IPv6 will be used, and installation of IPv6 is thus mandatory. Depending on the transmission media used, installation of IPv4 will also be possible as an option, in line with market trends.

Interface Specification for Application Layer Communication between
High-Voltage Smart Electric Energy Meters and EMS Controllers
1. Introduction

Date: Sep. 30, 2014
Version 1.00
CONFIDENTIAL
ECHONET CONSORTIUM

1.1. Definitions

EMS controller	A node that communicates with a high-voltage smart electric energy meter in ECHONET Lite in this specification.
High-voltage smart electric energy meter	A node that communicates with an EMS controller and provides various electric power data in ECHONET Lite in this specification.

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 or later
[ELOBJ]   ECHONET Specification APPENDIX: Detailed Requirements for
          ECHONET Device Objects, Release F or later

Interface Specification for Application Layer Communication between
High-Voltage Smart Electric Energy Meters and EMS Controllers
2. Application Layer

Date: Sep. 30, 2014
Version 1.00
CONFIDENTIAL
ECHONET CONSORTIUM

Chapter 2 Application Layer

ECHONET Lite [EL] will be adopted as the 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 high-voltage smart electric energy meters and EMS controllers shall be as shown below.

Table 2-1 ECHONET objects (EOJ)

	Group code	Class code	Class name	Instance code*
High-voltage smart electric energy meter	0x02	0x8A	High-voltage smart electric energy meter	0x01
	0x0E	0xF0	Node profile	0x01
EMS controller	0x05	0xFF	Controller	0x01
	0x0E	0xF0	Node profile	0x01

*The instance code shall be fixed at 0x01.

2.2. ECHONET Lite Services (ESV)

High-voltage smart electric energy meters and EMS 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

ESV = 0x60, 0x63, 0x6E, 0x74, 0x7A, 0x7E, 0x50, 0x53, and 0x5E shall not be subject to certification tests based on this Specification.

Date: Sep. 30, 2014
Version 1.00
CONFIDENTIAL
ECHONET CONSORTIUM

Interface Specification for Application Layer Communication between
High-Voltage Smart Electric Energy Meters and EMS Controllers
2. Application Layer

2.3. Object-Specific ECHONET Properties (EPC)

High-voltage smart electric energy meters shall install the ECHONET properties (EPC) of device objects shown in Tables 2-3 and 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	◎	—	—	
Production number	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 (high-voltage smart electric energy meter class requirements)

Property name	EPC	Access rule		Announcement at status change	Remarks
		Get	Set		
Operation status	0x80	◎	—	◎	
Coefficient	0xD3	◎	—	—	
Multiplying factor for coefficient	0xD4	◎	—	—	
Fixed date	0xE0	◎	—	—	
Day for which the historical	0xE1	◎	◎	—	

Interface Specification for Application Layer Communication between
High-Voltage Smart Electric Energy Meters and EMS Controllers
2. Application Layer

Date: Sep. 30, 2014
Version 1.00
CONFIDENTIAL
ECHONET CONSORTIUM

data of measured cumulative amounts of electric energy is to be retrieved					
Measured cumulative amount of active electric energy	0xE2	◎	—	—	
Cumulative amounts of active electric energy at fixed time	0xE3	◎	—	—	
Measurement data of cumulative amount of active electric energy for power factor measurement	0xE4	○	—	—	
Number of effective digits for cumulative amount of active electric energy	0xE5	◎	—	—	
Unit for cumulative amounts of active electric energy	0xE6	◎	—	—	
Historical data of measured cumulative amount of active electric energy	0xE7	◎	—	—	
Monthly maximum electric power demand	0xC1	◎	—	—	
Cumulative maximum electric power demand	0xC2	○			
Electric power demand at fixed time (30-minute average electric power)	0xC3	◎	—	—	
Number of effective digits of electric power demand	0xC4	◎	—	—	
Unit of electric power demand	0xC5	◎	—	—	
Historical data of measured electric power demand	0xC6	◎	—	—	
Unit of cumulative maximum electric power demand	0xC7	○	—	—	
Measurement data of reactive electric power consumption (lag) for power factor measurement	0xCA	◎	—	—	
Measurement data of cumulative amount of reactive electric power consumption (lag) at fixed time for power factor measurement	0xCB	○	—	—	

Date: Sep. 30, 2014
Version 1.00
CONFIDENTIAL
ECHONET CONSORTIUM

Interface Specification for Application Layer Communication between
High-Voltage Smart Electric Energy Meters and EMS Controllers
2. Application Layer

Number of effective digits for measurement data of cumulative amount of reactive electric power consumption (lag) for power factor measurement	0xCC	○	─	─	
Unit of measurement data of cumulative amount of reactive electric power consumption (lag)	0xCD	○	─	─	
Historical data of measurement data of cumulative amount of reactive electric power consumption (lag) for power factor measurement	0xCE	○	─	─	

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

2.4. Application Operation

2.4.1. Successive Requests

High-voltage smart electric energy meters and EMS 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 an EMS controller when a high-voltage 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 EMS controllers

Parameter name	Value	Remarks
Response wait timer 1	At least 40 [sec]	When the OPC value is 1, except when the EPC is as shown below. ・EPC=0xE7 Historical data of measured cumulative amount of active electric energy ・EPC=0xC6 Historical data of measured electric power demand

Date: Sep. 30, 2014
Version 1.00
CONFIDENTIAL
ECHONET CONSORTIUM

Interface Specification for Application Layer Communication between
High-Voltage Smart Electric Energy Meters and EMS Controllers
2. Application Layer

		・EPC=0xCE Historical data of measurement data of cumulative amount of reactive electric power consumption (lag) for power factor measurement

Response wait timer 2	At least 180 [sec]	When the OPC value is 2 or more, or when the EPC is as shown below.
		・EPC=0xE7
		 Historical data of measured cumulative amount of active electric energy
		・EPC=0xC6
		  Historical data of measured electric power demand
		・EPC=0xCE
		  Historical data of measurement data of cumulative amount of reactive electric power consumption (lag) for power factor measurement

The response wait timer values of a high-voltage smart electric energy meter when an EMS controller is responding to a request from it shall be based on Table 2-6.

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

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

2.4.3. Retransmission Processing

When high-voltage smart electric energy meters and EMS 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

High-voltage smart electric energy meters must be capable of supporting OPC value 11 or more and EMS controllers OPC value 3 or more. However, when receiving request messages including the EPC for historical data of measured cumulative amount of active electric energy, historical data of measured electric power demand, and historical data of measurement data of cumulative amount of reactive electric power consumption (lag) for power factor measurement described in 3.3.3, high-voltage smart electric energy meters need not support multiple OPCs. The maximum OPC values shown in this section are the values needed to process the messages shown in Chapter 3, and do not constitute requests to high-voltage smart electric energy meters for a response to combinations of various

Interface Specification for Application Layer Communication between
High-Voltage Smart Electric Energy Meters and EMS Controllers
2. Application Layer

Date: Sep. 30, 2014
Version 1.00
CONFIDENTIAL
ECHONET CONSORTIUM

properties up to OPC value 11.

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

2.4.5. Property Value Set Request

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

When a high-voltage smart electric energy meter receives a SetC[0x61] request from an EMS 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 an EMS controller receives Set_Res[0x71], set confirmation via Get[0x62] is not necessary.

2.5. Others

2.5.1. Treatment of Data Duplication

If an EMS controller receives duplicated cumulative amounts of active electric energy at fixed time, electric power demand at fixed time, and measurement data of cumulative amount of reactive electric power consumption (lag) at fixed time for power factor measurement from a high-voltage smart electric energy meter at the same measurement time, the data arriving last shall be taken as correct.

Date: Sep. 30, 2014
Version 1.00
CONFIDENTIAL
ECHONET CONSORTIUM

Interface Specification for Application Layer Communication between
High-Voltage Smart Electric Energy Meters and EMS Controllers
3. Standard Operation

Chapter 3 Standard Operation

In this Chapter, the standard operation between high-voltage smart electric energy meters and EMS controllers will be shown. High-voltage smart electric energy meters and EMS 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 high-voltage smart electric energy meter and an EMS controller. Here, it shall be assumed that network connection processing in the lower layer between high-voltage smart electric energy meters and EMS controllers has been completed.
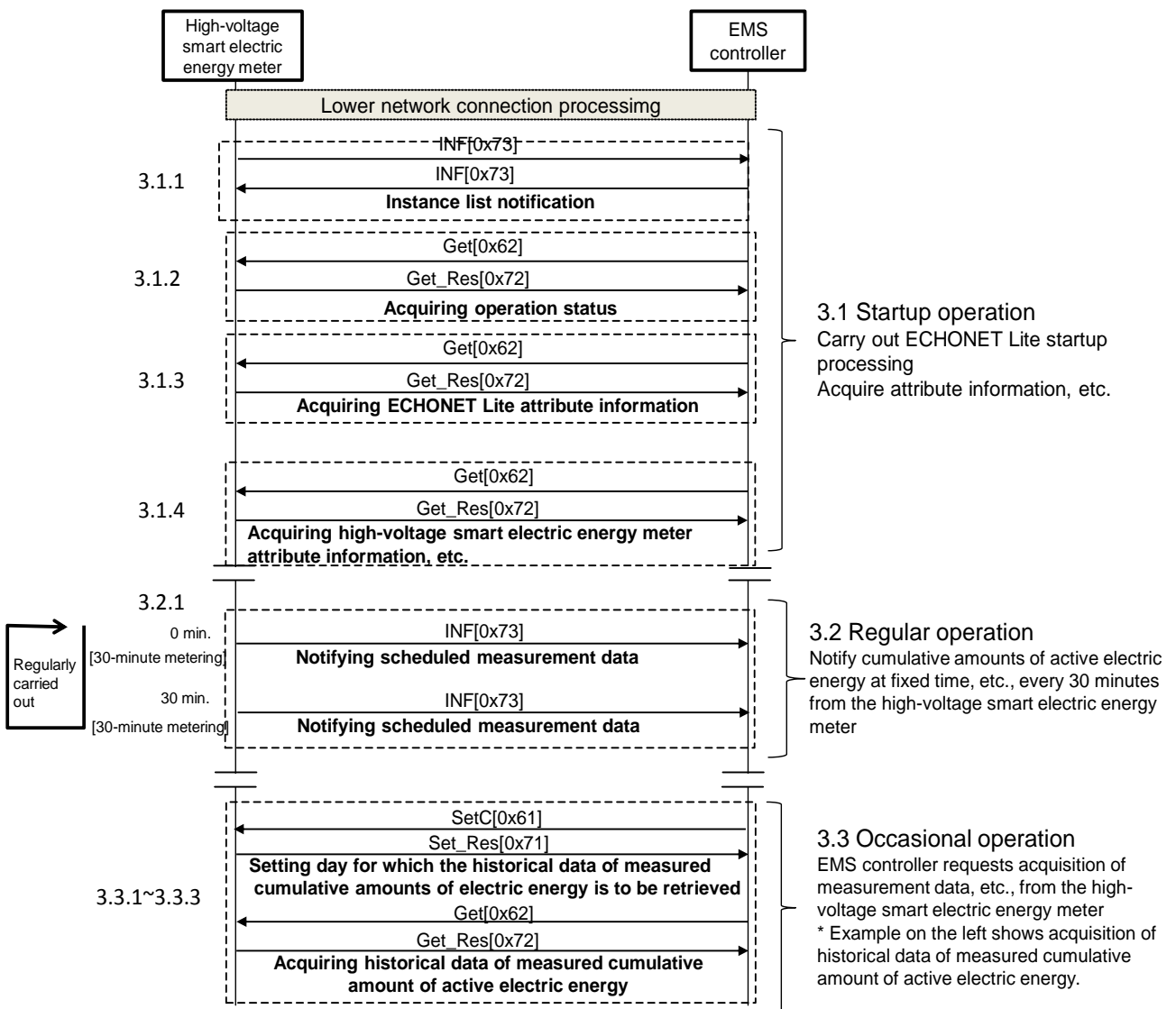

Fig. 3-1   Example of standard operating sequence

Interface Specification for Application Layer Communication between
High-Voltage Smart Electric Energy Meters and EMS Controllers
3. Standard Operation

Date: Sep. 30, 2014
Version 1.00
CONFIDENTIAL
ECHONET CONSORTIUM

3.1. Startup Operation

3.1.1. ECHONET Lite Node Startup Processing

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

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

3.1.2. High-Voltage Smart Electric Energy Meter Search Processing

In readiness for cases when the EMS controller is unable to receive the instance list notification sent by the high-voltage smart electric energy meter on startup, the EMS controller implements the process of searching for the high-voltage smart electric energy meter. Specifically, taking DEOJ as the high-voltage smart electric energy meter class (instance code: 0x00) and EPC as the operation status, it sends a read request by multicast.

(1)   Target properties (high-voltage smart electric energy meter class)
・   0x80: Operation status

3.1.3. Acquiring ECHONET Lite Attribute Information

After receiving instance list notification from the high-voltage smart electric energy meter, or after searching for the high-voltage smart electric energy meter, the EMS controller requests ECHONET Lite attribute information necessary for ECHONET Lite communication.

It is recommended that the EMS controller confirms the Appendix Release No. and properties installed with the high-voltage smart electric energy meter based on the ECHONET Lite attribute information, and makes requests in line with the installation status of the high-voltage smart electric energy meter.

(1)   Target properties (high-voltage 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.

Date: Sep. 30, 2014
Version 1.00
CONFIDENTIAL
ECHONET CONSORTIUM

Interface Specification for Application Layer Communication between
High-Voltage Smart Electric Energy Meters and EMS Controllers
3. Standard Operation

1. After receiving instance list notification from the high-voltage smart electric energy meter, the EMS controller requests target properties (combination and sequence may be arbitrary) via Get[0x62].

2. The high-voltage 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

3.1.4 Acquiring High-Voltage Smart Electric Energy Meter Attribute Information, etc.

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

(1)　Target properties (high-voltage smart electric energy meter objects)
・ 0x8D: Production number [optional property]
・ 0xD3: Coefficient
・ 0xD4: Multiplying factor for coefficient
・ 0xE0: Fixed date
・ 0xE5: Number of effective digits for cumulative amount of active electric energy
・ 0xE6: Unit for cumulative amounts of active electric energy
・ 0xC4: Number of effective digits of electric power demand
・ 0xC5: Unit of electric power demand
・ 0xC7: Unit of cumulative maximum electric power demand [optional property]

3-3

Date: Sep. 30, 2014
Version 1.00
CONFIDENTIAL
ECHONET CONSORTIUM

Interface Specification for Application Layer Communication between
High-Voltage Smart Electric Energy Meters and EMS Controllers
3. Standard Operation

- 0xCC: Number of effective digits for measurement data of cumulative amount of reactive electric power consumption (lag) for power factor measurement [optional property]
- 0xCD: Unit of measurement data of cumulative amount of reactive electric power consumption (lag) [optional property]

(2) Sequence

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

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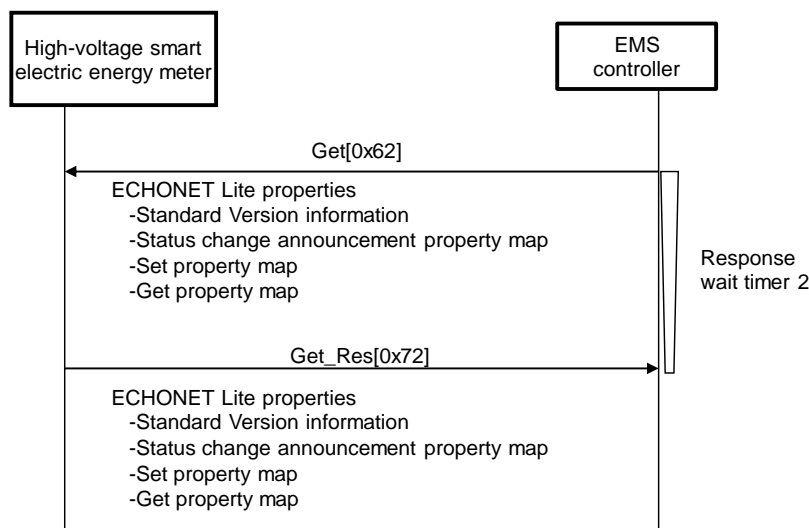2. The high-voltage smart electric energy meters transmit the relevant property value via Get_Res[0x72]. If an uninstalled optional property is requested, the relevant property is transmitted via Get_SNA[0x52].
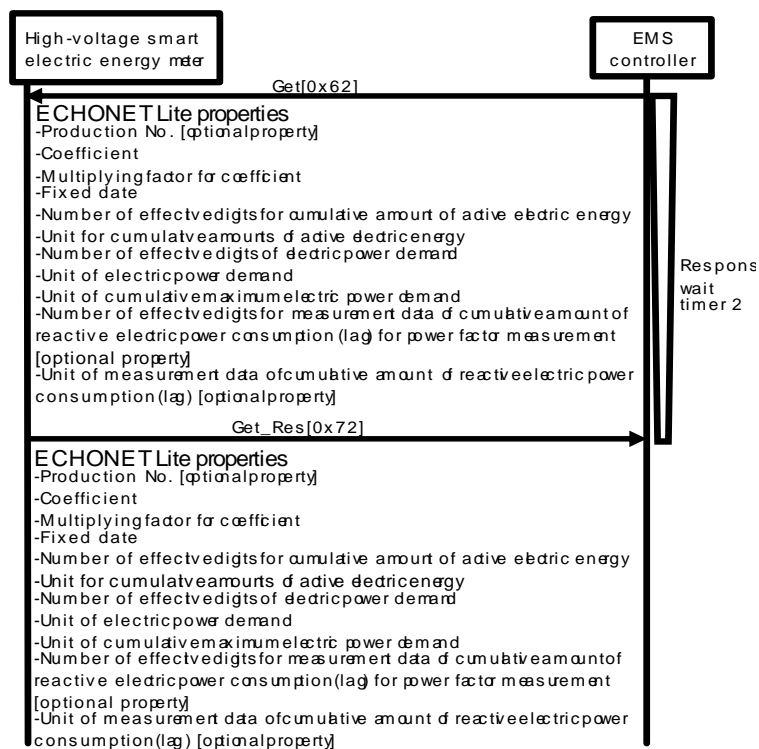
High-voltage smart
electric energy meter

EMS
controller

Get[0x62]

ECHONET Lite properties
-Production No. [optional property]
-Coefficient
-Multiplying factor for coefficient
-Fixed date
-Number of effective digits for cumulative amount of active electric energy
-Unit for cumulative amounts of active electric energy
-Number of effective digits of electric power demand
-Unit of electric power demand
-Unit of cumulative maximum electric power demand
-Number of effective digits for measurement data of cumulative amount of reactive electric power consumption (lag) for power factor measurement [optional property]
-Unit of measurement data of cumulative amount of reactive electric power consumption (lag) [optional property]

Response wait timer 2

Get_Res[0x72]

ECHONET Lite properties
-Production No. [optional property]
-Coefficient
-Multiplying factor for coefficient
-Fixed date
-Number of effective digits for cumulative amount of active electric energy
-Unit for cumulative amounts of active electric energy
-Number of effective digits of electric power demand
-Unit of electric power demand
-Unit of cumulative maximum electric power demand
-Number of effective digits for measurement data of cumulative amount of reactive electric power consumption (lag) for power factor measurement [optional property]
-Unit of measurement data of cumulative amount of reactive electric power consumption (lag) [optional property]

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

Interface Specification for Application Layer Communication between
High-Voltage Smart Electric Energy Meters and EMS Controllers
3. Standard Operation

Date: Sep. 30, 2014
Version 1.00
CONFIDENTIAL
ECHONET CONSORTIUM

3.2. Regular Operation

3.2.1. Notifying Scheduled Measurement Data

The high-voltage smart electric energy meter notifies the latest cumulative amounts of active electric energy at fixed time, electric power demand at fixed time, and measurement data of cumulative amount of reactive electric power consumption (lag) at fixed time for power factor measurement to the EMS controller within 5 minutes of 00 minutes and 30 minutes after every hour.

(1)   Target properties (high-voltage smart electric energy meter objects)

0xE3: Cumulative amounts of active electric energy at fixed time

0xC3: Electric power demand at fixed time

0xCB: Measurement data of cumulative amount of reactive electric power consumption (lag) at fixed time for power factor measurement [optional property]

(2)   Sequence

Fig. 3-4 shows an example of the sequence for notification of cumulative amounts of active electric energy at fixed time, electric power demand at fixed time, and measurement data of cumulative amount of reactive electric power consumption (lag) at fixed time for power factor measurement.

1.   The high-voltage smart electric energy meter notifies target properties (combination and sequence may be arbitrary) to the EMS controller by broadcast transmission via INF[0x73] within 5 minutes of 00 minutes and 30 minutes after every hour.
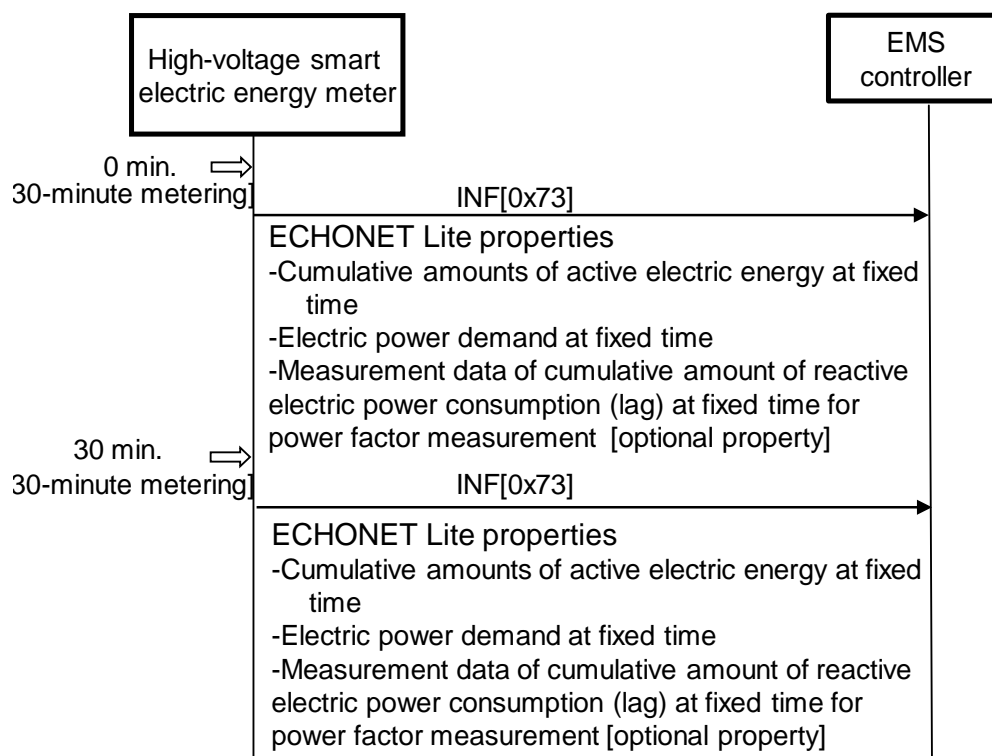
Date: Sep. 30, 2014
Version 1.00
CONFIDENTIAL
ECHONET CONSORTIUM

Interface Specification for Application Layer Communication between
High-Voltage Smart Electric Energy Meters and EMS Controllers
3. Standard Operation

Fig. 3-4   Example of sequence for notifying scheduled measurement data

3.3. Occasional Operation

3.3.1. Acquiring Scheduled Measurement Data

If necessary, the EMS controller makes a request to the high-voltage smart electric energy meter for cumulative amounts of active electric energy at fixed time, electric power demand at fixed time, and measurement data of cumulative amount of reactive electric power consumption (lag) at fixed time for power factor measurement. Normally, this is notified from the high-voltage 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 (high-voltage smart electric energy meter objects)
・   0xE3: Cumulative amounts of active electric energy at fixed time
・   0xC3: Electric power demand at fixed time
・   0xCB: Measurement data of cumulative amount of reactive electric power consumption (lag) at fixed time for power factor measurement [optional property]

(2)   Sequence
Fig. 3-5 shows an example of the sequence for acquiring cumulative amounts of active

3-6

Interface Specification for Application Layer Communication between
High-Voltage Smart Electric Energy Meters and EMS Controllers
3. Standard Operation

Date: Sep. 30, 2014
Version 1.00
CONFIDENTIAL
ECHONET CONSORTIUM

electric energy at fixed time, electric power demand at fixed time, and measurement data of cumulative amount of reactive electric power consumption (lag) at fixed time for power factor measurement.

1. If the EMS controller is unable to receive cumulative amounts of active electric energy at fixed time, electric power demand at fixed time, and measurement data of cumulative amount of reactive electric power consumption (lag) at fixed time for power factor measurement, it requests necessary data such as "Cumulative amounts of active electric energy at fixed time" via Get[0x62], targeting 05 minutes and 35 minutes after every hour or later.

2. The high-voltage 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.
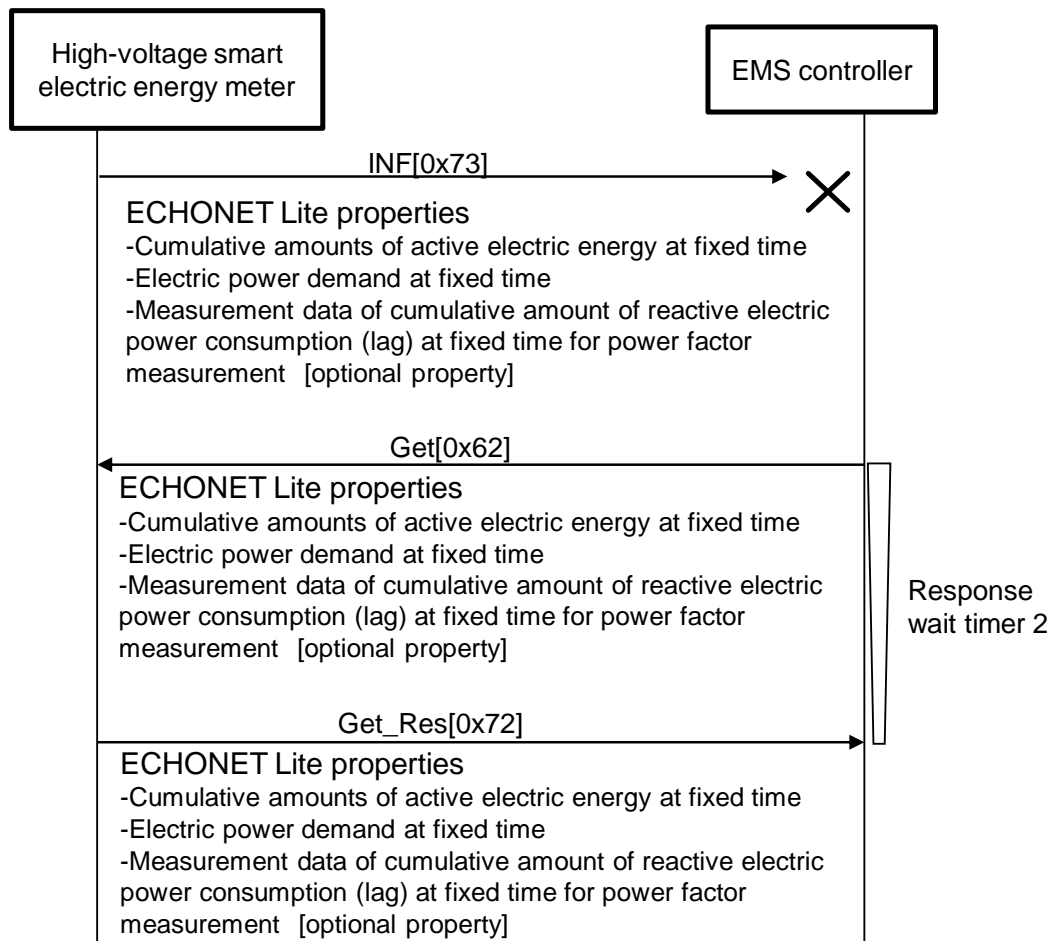

Fig. 3-5   Example of sequence for acquiring scheduled measurement data

Interface Specification for Application Layer Communication between
High-Voltage Smart Electric Energy Meters and EMS Controllers
3. Standard Operation

Date: Sep. 30, 2014
Version 1.00
CONFIDENTIAL
ECHONET CONSORTIUM

3.3.2. Acquiring Measurement Data from High-Voltage Smart Electric Energy Meters

If necessary, the EMS controller requests measurement data from the high-voltage smart electric energy meter.

(1)　　Target properties (high-voltage smart electric energy meter objects)
・ 0xE2: Measured cumulative amount of active electric energy
・ 0xE4: Measurement data of cumulative amount of active electric energy for power factor measurement [optional property]
・ 0xCA: Measurement data of reactive electric power consumption (lag) for power factor measurement [optional property]

(2)　　Sequence
Fig. 3-6 shows an example of the sequence for acquiring measurement data from a high-voltage smart electric energy meter.

1. The EMS controller requests target properties (combination and sequence may be arbitrary) via Get[0x62].
2. The high-voltage smart electric energy meter transmits the relevant property value via Get_Res[0x72].
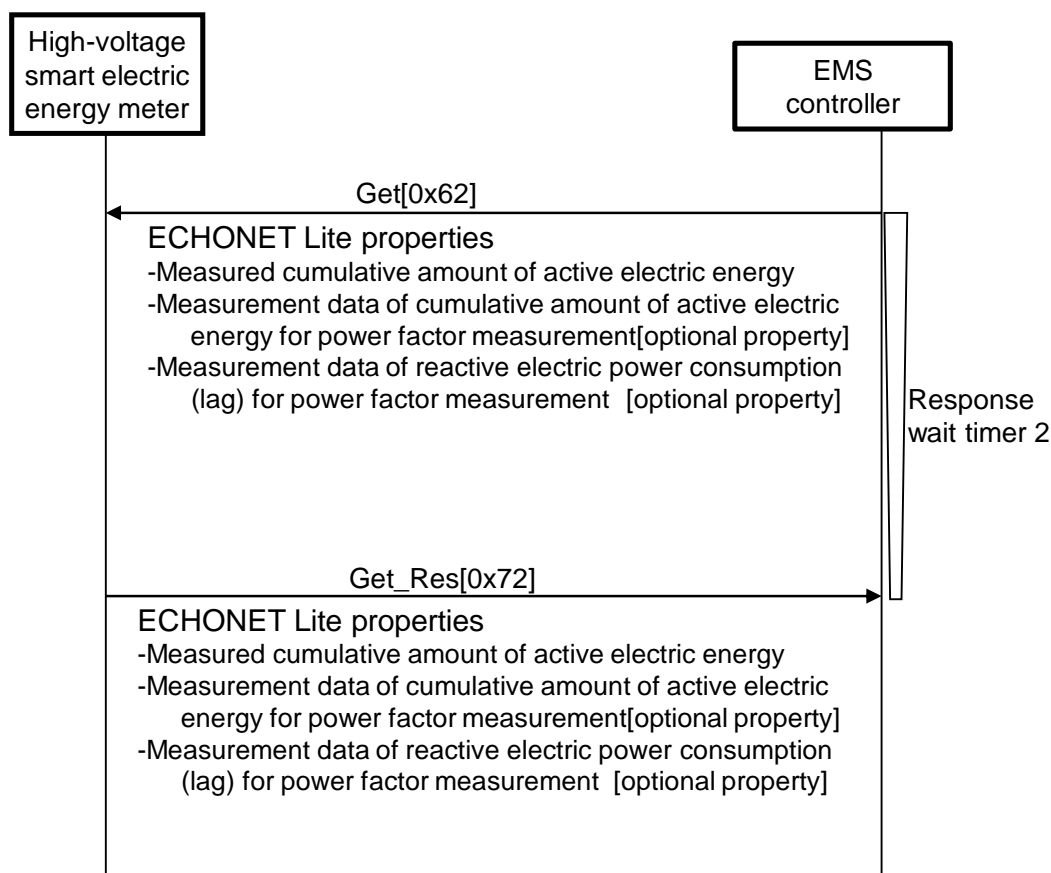
Date: Sep. 30, 2014
Version 1.00
CONFIDENTIAL
ECHONET CONSORTIUM

Interface Specification for Application Layer Communication between
High-Voltage Smart Electric Energy Meters and EMS Controllers
3. Standard Operation

Fig. 3-6 Example of sequence for acquiring measurement data from high-voltage smart electric energy meters

3.3.3. Acquiring Historical Measurement Data

If necessary, the EMS controller requests historical data of measured cumulative amount of active electric energy, historical data of measured electric power demand, and historical data of measurement data of cumulative amount of reactive electric power consumption (lag) for power factor measurement.

(1)   Target properties (high-voltage smart electric energy meter objects)
・ 0xE1: Day for which the historical data of measured cumulative amounts of electric energy is to be retrieved
・ 0xE7: Historical data of measured cumulative amount of active electric energy
・ 0xC6: Historical data of measured electric power demand
・ 0xCE: Historical data of measurement data of cumulative amount of reactive electric power consumption (lag) for power factor measurement [optional property]

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

Date: Sep. 30, 2014
Version 1.00
CONFIDENTIAL
ECHONET CONSORTIUM

Interface Specification for Application Layer Communication between
High-Voltage Smart Electric Energy Meters and EMS Controllers
3. Standard Operation

cumulative amount of active electric energy, historical data of measured electric power demand, and historical data of measured cumulative amounts of reactive electric energy (lag) for power factor measurement.

1. If the EMS controller needs the "Historical data of measured cumulative amount of active electric energy", "Historical data of measured electric power demand", and "Historical data of measurement data of cumulative amount of reactive electric power consumption (lag) for power factor measurement", it sets the time needed in "Day for which the historical data of measured cumulative amounts of electric energy is to be retrieved" and makes a request via SetC[0x61].

2. After completing the set of the settings (EDT) designated by SetC[0x61], the high-voltage 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 EMS controller requests one of "Historical data of measured cumulative amount of active electric energy", "Historical data of measured electric power demand", or "Historical data of measurement data of cumulative amount of reactive electric power consumption (lag) for power factor measurement" via Get[0x62].

4. The high-voltage smart electric energy meter transmits the relevant property value via Get_Res[0x72]. When it does not have the measurement data for the time in question, the data will be void, and the value will be given as 0xFFFFFFFE. If the normal value cannot be responded owing to a fault, Get_SNA[0x52] is transmitted.

5. If the EMS controller also needs other historical data, it requests one of "Historical data of measured cumulative amount of active electric energy", "Historical data of measured electric power demand", or "Historical data of measurement data of cumulative amount of reactive electric power consumption (lag) for power factor measurement" via Get[0x62].

6. The high-voltage smart electric energy meter transmits the relevant property value via Get_Res[0x72]. When it does not have the measured electric energy for the time in question, the data will be void, and the value will be given as 0xFFFFFFFE. If the normal value cannot be responded owing to a fault, Get_SNA[0x52] is transmitted.

Date: Sep. 30, 2014
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Interface Specification for Application Layer Communication between
High-Voltage Smart Electric Energy Meters and EMS Controllers
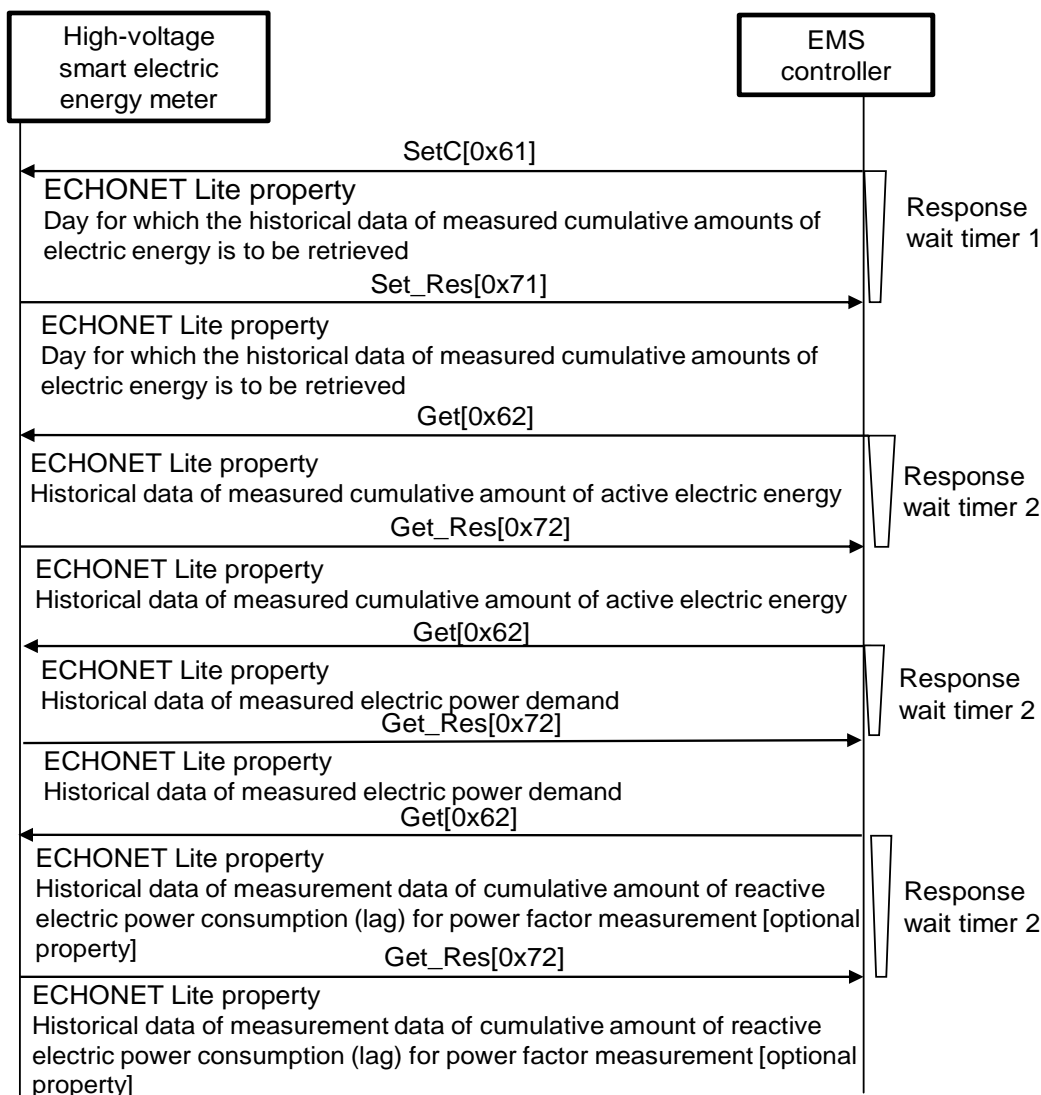3. Standard Operation

Fig. 3-7   Example of sequence for acquiring historical measurement data

3.4. Operation during a Fault

3.4.1. Fault Status Notification

If the high-voltage smart electric energy meter succumbs to a fault status making it unable to transmit the cumulative amounts of active electric energy at fixed time, etc., it notifies the fault status ("Fault occurred") to the EMS controller. When it has recovered from the fault, it notifies the fault status ("No fault has occurred") to the EMS controller.

During the fault, the high-voltage smart electric energy meter does not notify the cumulative amounts of active electric energy at fixed time and others described in 3.2.1. Operation of the EMS controller is not required while the high-voltage smart electric energy meter is in fault status.

Interface Specification for Application Layer Communication between
High-Voltage Smart Electric Energy Meters and EMS Controllers
3. Standard Operation

Date: Sep. 30, 2014
Version 1.00
CONFIDENTIAL
ECHONET CONSORTIUM

(1)   Target properties (high-voltage smart electric energy meter objects)

0x88: Fault status