Basic Concept for Smart Meter Specification based on RFC

July 12, 2012

Tokyo Electric Power Company, Incorporated

TEPCO

TOKYO ELECTRIC POWER COMPANY

Introduction

Nuclear Damage Liability Facilitation Fund (hereinafter, “the Fund”) and Tokyo Electric Power Company (hereinafter, “TEPCO”) invited comments for the specification concerning metering part (March 13 – April 13) and communication part and others (March 21 – April 20) of smart meters to be installed by TEPCO.

As a result, a total of 88 companies, groups, and individuals came back with 482 comments about communication methods, data formats, system expansions, the significance of introducing smart meters, and so forth.

This document presents the basic concept which the Fund and TEPCO established after having consultation between each other, according to the received comments and the proposals from Fund’s advisors.

Hereafter, together with Fund and advisors, we will establish and publish detailed specification on smart meter system, and then take action of Request for Proposal (RFP) regarding communication systems.

Standpoint of Deploying Smart Meter System

We are now working on rationalization for more than 3.3 trillion yen in ten years according to the “Special Business Plan.” Above all, we consider smart meter deployment is important for rationalization, because it enables us to reduce measurement cost and reduce the future capital investment by launching Demand Response menus, which can be realized by using a variety of rate menu, visualization of the electricity use, control of appliances and so on.

We will reduce our capital investment by fully using the outside knowledge and others’ infrastructure in purchasing smart meters. And we consider it important to reduce costs deeply by publishing open specifications to make it easier to enter among domestic and international vendors, and by promoting competition.

In addition, we are not only pursuing economic rationality but also the smart meter network to be a system with technical expandability as a social infrastructure, which will realize Demand Response and become the basis for future services using the meter reading.

Special Business Plan (Excerpt) (May 2012, by the Fund and TEPCO)

Procurement of the large amount of smart meters, which are expected to be the infrastructure for the new social growth, has to apparently represent the "New TEPCO" business attitude. A drastic reform of procurement procedure such as international procurement or having advice outside the company will be performed, not by the closed custom of procurement from the affiliated companies, so called "family companies," nor companies having continuous contract, to reduce cost even more and improve transparency in business.

In concrete terms, specification of metering part and communication part have been published under the Request for Comment (RFC) procedure to domestic and international companies in March this year. The results from "Smart House Standardization Study Group" (February 24, 2012) held in "Japan Smart Community Alliance※" have to be reflected as a prerequisite, and adoption of the submitted comments and decision of the specification has to be consulted by TEPCO and the FUND.

Beyond that, TEPCO plans to introduce 17 million households with smart meters, and at least by FY 2023, to the whole 27 million households. In case customer wishes to install smart meter, TEPCO individually install the smart meter as the rate changes, and accelerate the time earlier to install the whole residents. By this, promotes energy savings in households or small enterprise users, and reduce future investments as well as reducing the cost for AMI.

Our objective is to realize the world's leading Smart Society , by building the infrastructure at low cost which expands new technology and business for HEMS (Home Energy Management System), introducing meters which assure further possibilities of development.

※JSCA was established in April 2010 for deploying the Smart Community, plan and promote activities beyond industries, share information necessary for international deployment, and promote smart community within government and industries together.

Background and Future Plan

- March 13, 2012～April 13, 2012: RFC on Metering Part
- March 21, 2012～April 20, 2012: RFC on Basic Specification of Communication
- April 23, 2012: Advisors for evaluating the specification of the smart meter in Nuclear Damage Liability Facilitation Fund assigned

- July 12, 2012: References below published

1) Results of RFC

2) Basic Concept for Smart Meter Specifications based on RFC (this document)

3) Proposals from the advisors in Nuclear Damage Liability Facilitation Fund

- August, 2012 ～ September, 2012: TEPCO, the FUND, and including other external experts will discuss further based on this document.
- After October, 2012: We will conduct the following 3 points based on the further discussion.

1) Publish detailed specification of system development (MDMS etc.), and public offering of system developer

2) RFP for communication system

3) Publish new specification of manufacturing smart meter (metering part)

- To correspond to the new specification according to the results of RFC, a certain period will be necessary for the new entrants and so on. Therefore we cancel the bidding originally planned in October 2012 (for the installation of Fiscal Year 2013), and the bidding will become open for the installation at the beginning of Fiscal Year 2014.

Results of the RFC for Smart Meter

RFC for metering part (Mar.13～Apr.13) ：Submitter: 16 (Corporate 16), Comments: 160*
RFC for communication part (Mar.21～Apr.20) ：Submitter: 72 (Corporate 61, Group 7, Individual 4), Comments: 322*

Category of comments	Detailed number of comments (Approximation)		
	meterimg	Communi -cation	total
(1) Adoption of international standards ○ MDMS interface, implementation of IP, data format of metering data, transmission protocol etc.	5	40	45
(2) Communication system ○ Communication system of the backhaul (private network/telecommunication service provider network), communication system around meter (RF mesh, PLC, Star) etc.	1	200	200
(3) Cost reduction, expandability ○ Make up of metering and communication part (Integrate, Separate) ○ Meter reading interval, transmission frequency, specification of route B, new services etc.	5	90	95
(4) Total system, further study ○ Necessity to study as the total system etc.	10	80	90
(5) Measurement specification, etc. ○ Addition or mitigation of meter function and condition, improvement of design restriction etc.	180	10	190
Total	200*	420*	620*

※The category of received comments are classified by TEPCO.
(*) The number of “Comments” is based on the number of submitted application form. If several comments are written in the same application form, the comments are counted in “Detailed number of comments.”

- Table of Contents -

Three Viewpoints Revising the Specification

- Revising the specification based on RFC, three viewpoints were set.
- Based on the three viewpoints, new concepts are presented below regarding major comments from RFC.

1. Achieving the intensive cost reduction

○Utilize the other service provider's existing infrastructure to suppress the capital investment in middle and long term, rather than constructing privately owned infrastructure.
○Materials and communication protocol will be in open specification in order to enable to procure equipments at least cost by bidding by companies from domestic and overseas.

2. Securing the external interconnectivity

○Open standard communication protocol will be adapted so that services providers who wants to provide various services can access meter data easily.
○Ensure security to prevent access from malicious intent.

3. Securing the technical expandability

○Foreseeing variety of future services, ensure the possible expandability sufficiently.
○Provide flexibility of utilizing various communication method including telecommunication service providers' infrastructure in "right method in right place."

Ⅰ-1. Adoption of International Standards

■We adopt open international standard in view of the other utilities providing various energy services and customers that may use meter data, and cost reduction.

(1)Interface of International Standards

- Foreseen the full-scale liberalization of the electricity business, we will change our concept to adopt open standard interfaces in view of securing interconnection between external systems and MDMS which collect meter data, and reducing the development term and cost.

(2)Implementing IP

- Connection of smart meter and electric company (Route A) will be basically changed to adopt IP because external providers may use the meter data and can secure flexible expandability for future services, and it can reduce cost in long term by enabling multiple IT vendors and manufacturers to enter.

(3)Data format of International Standards

- International standards for metering data and transmission protocols will be basically adopted, compared to other specifications, considering development cost and security. However, if TEPCO's conventional specification is admitted to have advantages, TEPCO's specification will be open and enable various suppliers to enter.

Ⅰ-2. Deploying Communication Media that Fits in the Right Place

■In construction of the communication network, we will deploy the right media in the right place, depending on the characteristics of each communication media, and pursue minimum total cost.

(1)Communication method of the Backhaul (WAN/Wide Area Network)

- Especially in the areas where optical fiber networks are not deployed, it may cost expensive to build, maintain and operate facilities if we deploy optical fiber networks for WAN, compared to other methods, at least in short and middle terms. Therefore, in such area, we will change our plan to basically utilize telecommunication service providers' wireless star networks or optical fiber networks in such area, thoroughly comparing the cost.

(2)Communication method around the meters (FAN/Field Area Network)

- For FAN, RFP will be issued for wireless star network, RF-mesh, and PLC, and assessment of value per cost will be carried out by considering the characteristics of proposed technology, realization of communication, cost and so on. Total best practice in long term will be performed by implementing multiple types of method by allocating the media in the suitable area.

Ⅰ-3. Intensive Cost Reduction and Securing the Expandability of Smart Meter Function

■Implementing functions of smart meter shall meet the current required functions, and shall be considered to have expandability of functions at realistic and reasonable extent.

(1)Adoption of integrated meter

- The making of the smart meter of measuring part and communication part will be changed to admit integrated type in addition to the separate type, considering the cost reduction by decreasing the number of components.

(2)Transmission frequency of meter reading

- The interval to send the meter reading shall basically be 30 minutes for route A. However, in foreign countries, interval of several hours ～ several days are mainly adopted. Therefore, considering the following RFP and results of evaluation, changing the frequency of transmission may be discussed to reduce cost, having the function of changing the interval as a precondition.

(3)Specification of Route B

- For the specification of route B, we will reflect the context of interim results from the Smart House Standardization Study Group, and discuss the detailed specifications with the related organizations.

(4)Flexibility for new services

- Adopting the expected future new services such as Demand Response of controlling home appliances, gas and water joint metering, shall be enabled by remote software update.

- Table of Contents -

I. Concept for Revising the Specification

II. Major Revisions from Previous Specification

Description

Newly Added : newly added part of specification by revision

Modified : modified part of specification by revision

・The part added or modified is written in red.

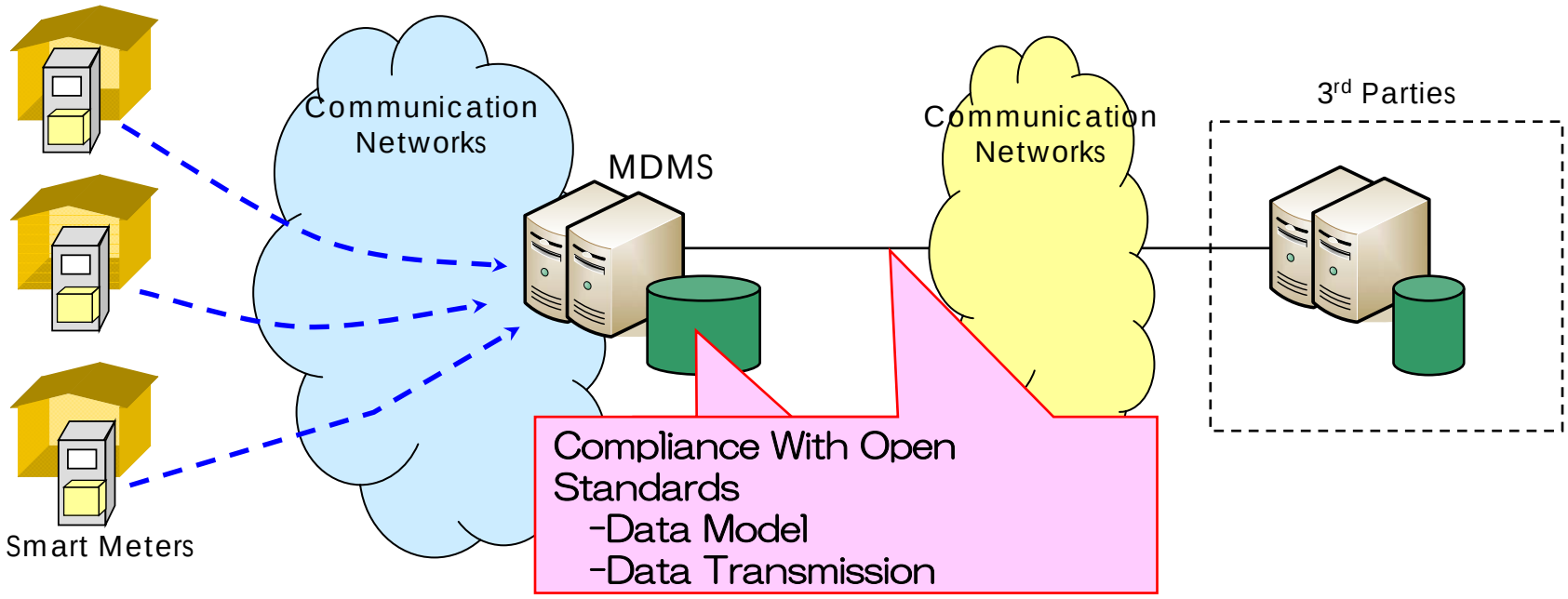
Not Modified : The part with nothing changed

Ⅱ-1. Adoption of International Standards (1) -Interface-

Newly Added

■MDMS's external interfaces for 3rd parties' systems will comply with open standards.

- Employing standardized data format and transmission protocols, interconnection will be secured easily between systems.



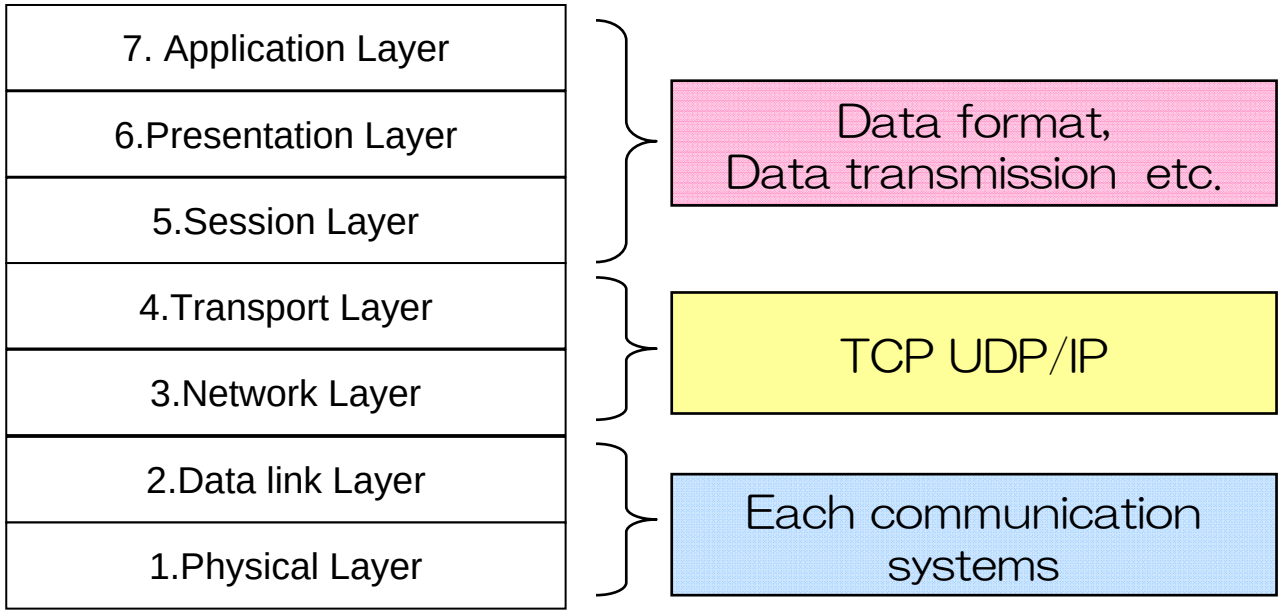
Newly Added

Ⅱ-1. Adoption of International Standards (2) -IP-based network-

■AMI network (route A) will be IP-based network in principle.

- Adopting IP will enable to separate communication systems (wireless communications etc.) and data transmission (e.g. Standards for meter data structure defined in IEC or ANSI etc.), which make flexible system for future change or expanding function.

<Communication protocol for route A>

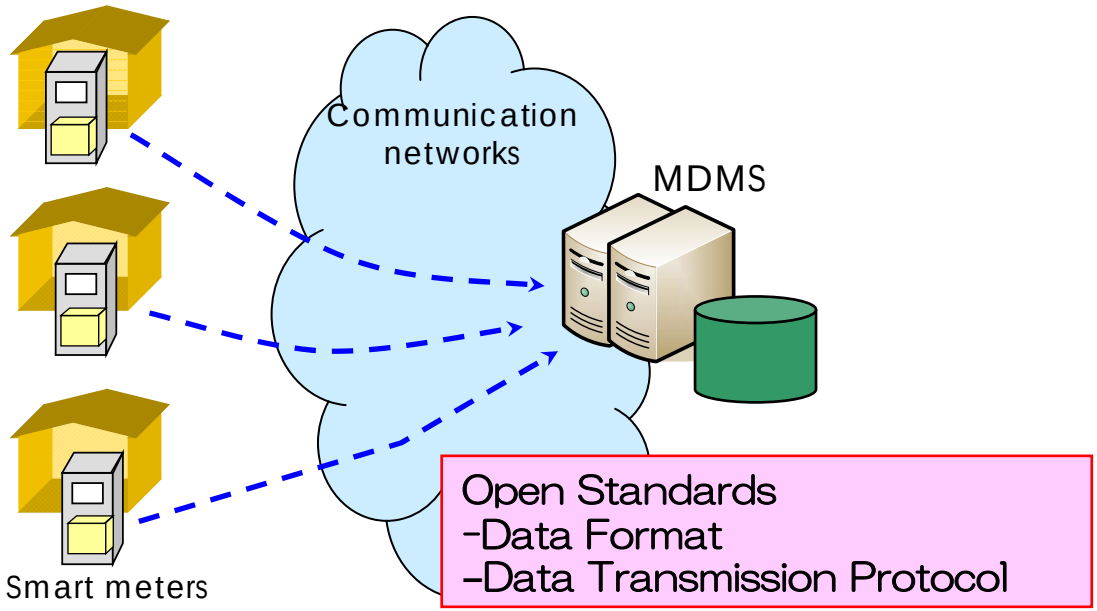


Ⅱ-1. Adoption of International Standards (3) -Data format-

Newly Added

■TEPCO will aim to deploy international standards for metering data format and transmission protocols.

- International standards will be basically adopted for metering data and transmission protocols considering and comparing development cost and security. However, if TEPCO's conventional specification is admitted to have advantages, TEPCO's specification will be open and become available to enter various vendors.



Newly Added

Ⅱ-2. Deploying Right Communication Method in the Right Place (1) –WAN-

- Especially, in the areas where optical fiber networks are not deployed, it may cost expensive to build, maintain and operate facilities if we deploy optical fiber networks for WAN, compared to other methods, at least in short and middle terms. Therefore, we will basically utilize telecommunication service providers' wireless star networks or optical fiber networks by thoroughly comparing the cost in such area.

<Candidates of Communication Systems>

(1)Private Optical Fiber Network	● TEPCO's optical fiber; Inside National route 16, optical fibers have been constructed a lot but scarcely outside of it.
(2)Wireless Star Network	● Star network such as 3G/PHS/WiMax; mostly available in TEPCO's areas.
(3)3rd Parties' Optical Fiber Network	● Optical fiber owned by telecommunication service providers; exists widely more than TEPCO's optical fiber.

Modified

Ⅱ-2. Deploying Right Communication Method in the Right Place (2) –FAN-

- In order to build communication networks which serve our 27 million customers, we need to utilize appropriate communication systems according to several geographies such as dense residence area, underground city, high-raised apartments, rural and mountainous area.
- As for FAN, we will carry out RFP regarding wireless star network, RF mesh network and PLC, and will evaluate cost-effectiveness, considering proposed technical features, communication feasibility, cost and so on. In long term, implementing multiple communication systems in right-communication-method-in-the-right-place basis, we will realize total optimization.

<Candidate of Communication Systems>

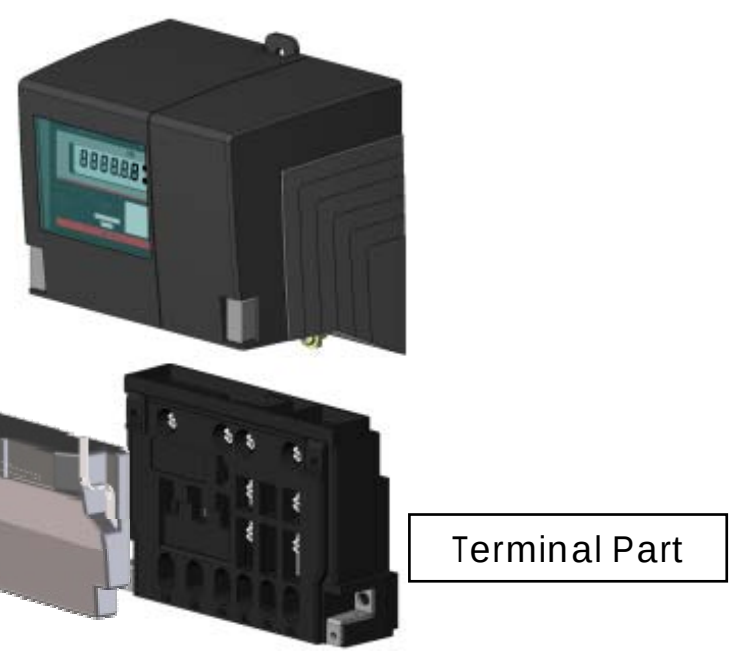
(1)RF mesh network	● Transmits data via other wireless terminals with a bucket-brigade using a relatively low-power radio
(2)Wireless star network	● Transmits data between a base station and wireless terminal directly using a relatively high-power radio
(3)PLC （Power Line Communications）	● Utilizes electrical power lines as communication lines

Newly Added

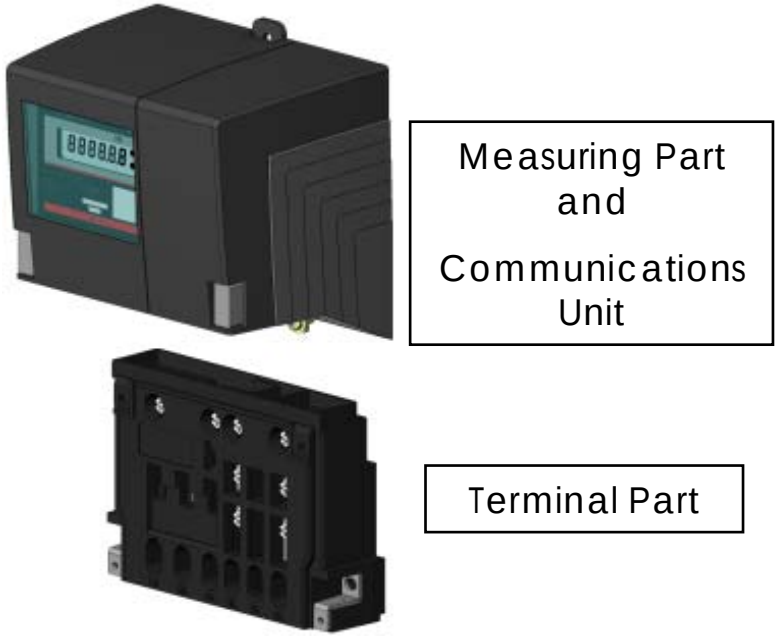
Ⅱ-3. Functions of Smart Meter (1) –Adoption of integrated structure-

- As for the structure of the measuring part and the communication part of the smart meter, we will adopt integrated structure as well as separated structure, considering possibilities to reduce cost by decreasing the number of parts.

Separated Structure Meter



Integrated Structure Meter



Ⅱ-3. Functions of Smart Meter (2) -Specification for Route B-

Modified

■Regarding communications between a smart meter and HEMS (route B), results from study at “Smart House/Building Standardization and Business Promotion Study Group” (Secretariat : Ministry of Economy, Trade and Industry) will be reflected and implemented into our systems, as well as the interim results from “the Smart House Standardization Study Group” to use ECHONET Lite.

〈Subjects to be discussed in “Smart House/Building Standardization and Business Promotion Study Group”〉

(1)Identification and implementation for the lower layer (Transmission medium) critical devices

-Identification for 8 critical devices (candidate)
Smart Meter, Photo voltaic system, Storage battery, Fuel battery, EV/PHV, Air Conditioner, Lighting, Water Heater

- Identification and implementation for the lower layer of 8 critical devices

(2)Implementation of operation manual for critical devices
(3)Interconnectivity test and device conformance for multi vender

- Preparation for the operation manuals regarding HEMS deployment, connection and maintenance
  As for the connection between HEMS and critical devices, manual defining the sharing of responsibilities, collaboration etc. will be needed.
- Preparation for Guidelines of product safety and managing responsibility for connecting HEMS
- Preparation for the training manuals regarding HEMS deployment, connection and maintenance.

(4)Promotion for international standardization of ECHONET-Lite

Japan	The U.S.
ECHONET Lite (Established)	SEP 2.0 (Draft)
• Variety of controls for appliances about 80 types of inside/outside home, including smart meters, PV, storage batteries, are available.	• Limited controls such as turning off/on central A/C and Pumps for pool are available. Variation of control for other appliances will be discussed.
• Consumer-driven control	• Power Company-driven control

connection and complement will be available

(5)Developing standards for Demand Response system

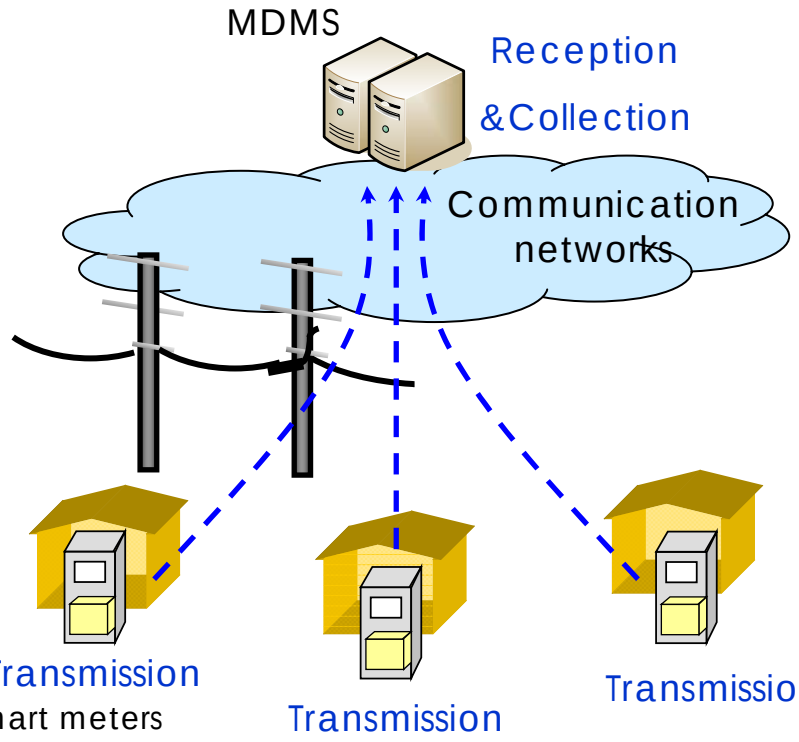
Excerpt from “The First Meeting of JSCA Smart House/Building Standardization and Business Promotion Study Group,” June 22, 2012

Modified

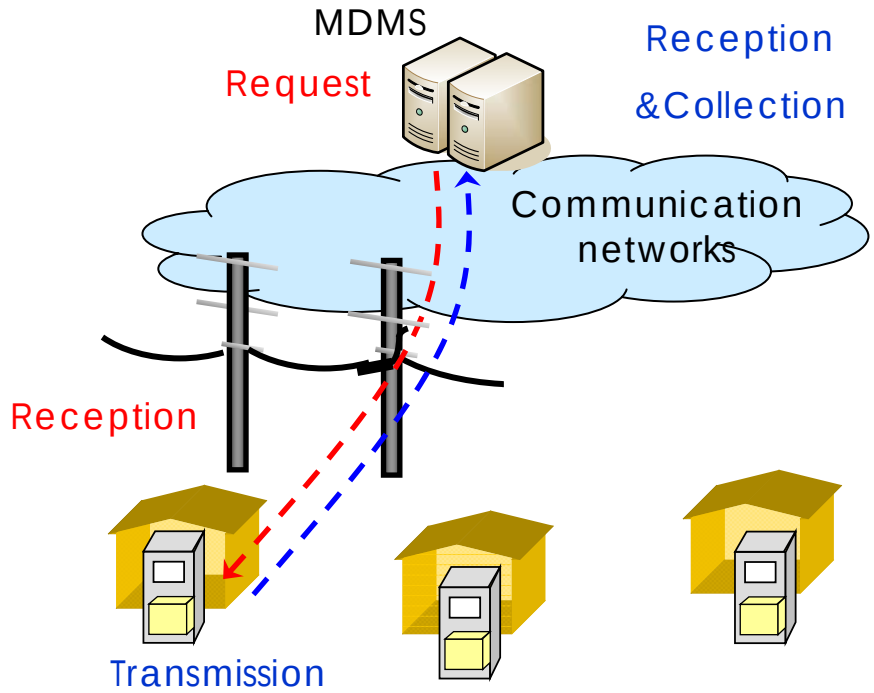
Ⅱ-3. Functions of Smart Meter (3) -30-minute meter reading-

- Smart meters transmit 30-minute meter reading to the MDMS according to designated interval. Transmission interval shall basically be 30 minutes, and can be changed with the expandable function.
- In case of loss of meter reading occurs, meters retransmit the data according to the request from MDMS such as acknowledgement of connection recovery and re-reading order.

〈Periodic Collection〉



〈Individual Collection (loss of data)〉

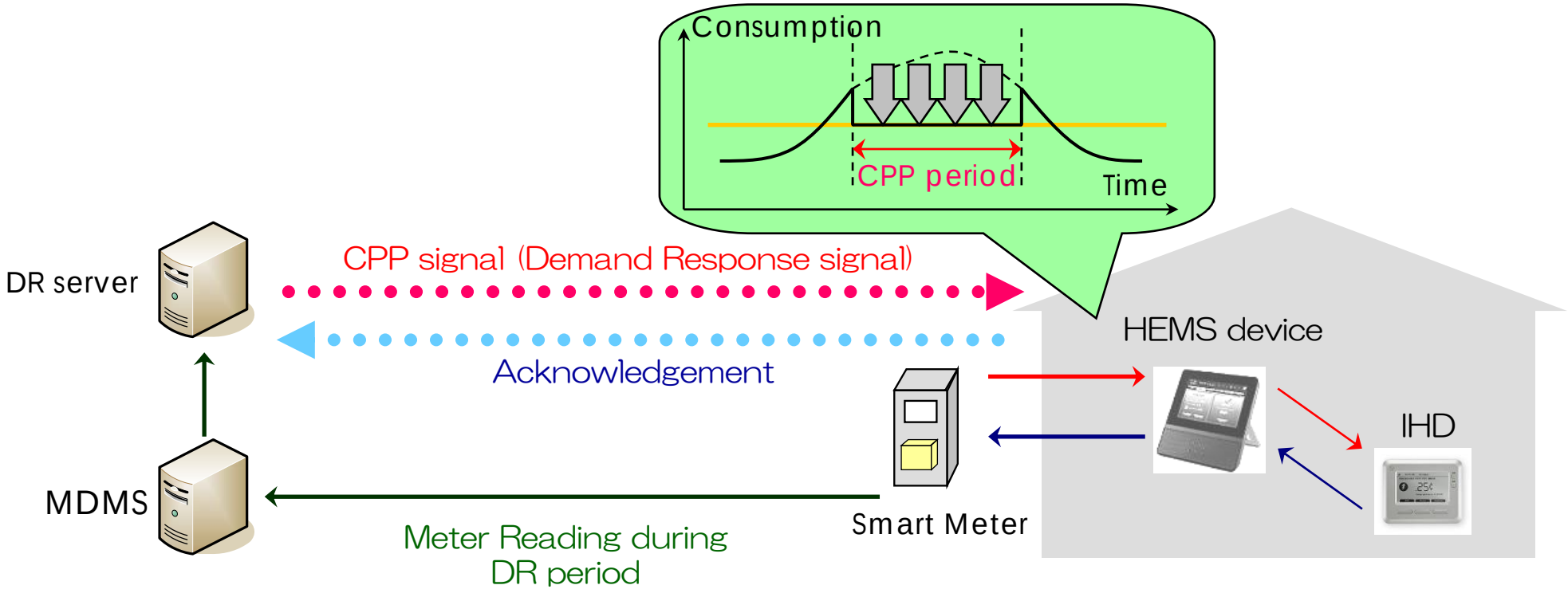


Ⅱ-3. Functions of Smart Meter (4) - Demand Response -

Newly Added

- Smart meters transmit and handle DR signals according to DR services such as CPP (Critical Peak Pricing) , PTR (Peak Time Rebate) and so on.
- For newly designated DR services, the interface which can install additional functions will be equipped sufficiently.

Example of DR functions ：CPP（Critical Peak Pricing）

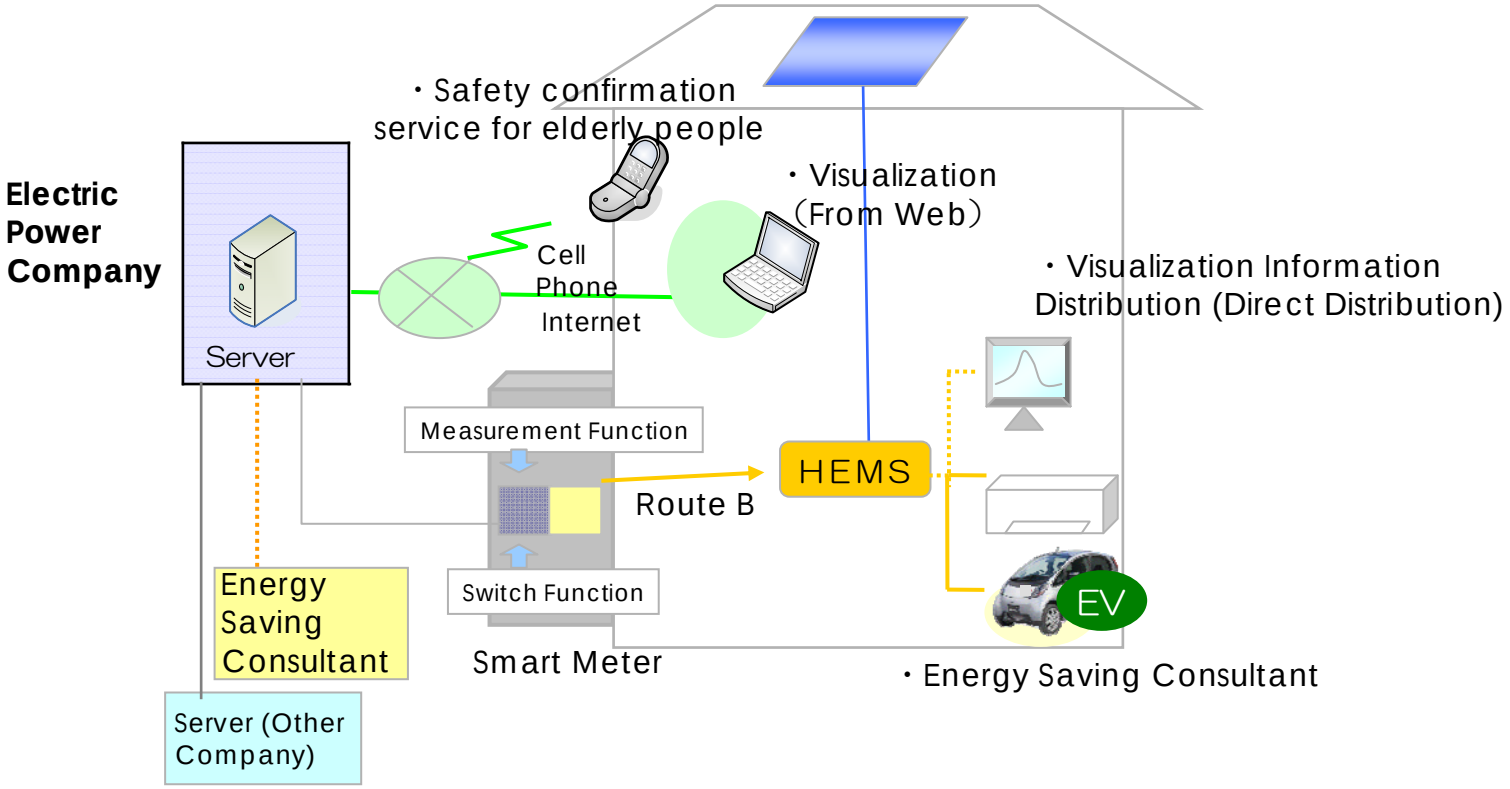


Newly Added

Ⅱ-3. Functions of Smart Meter (5) - Future Services -

- We assume co-metering with gas and water company, visualization service of electric consumption, nega-watt aggregation business, safety confirmation service for elderly people and energy conservation/energy saving advice as specific services.
- Interface in the smart meter which can additionally implement the desirable functions for future services will be equipped sufficiently. In this case, system architecture must secure fairness for new comers such as new energy business supplier's in the wake of future full electricity deregulation.

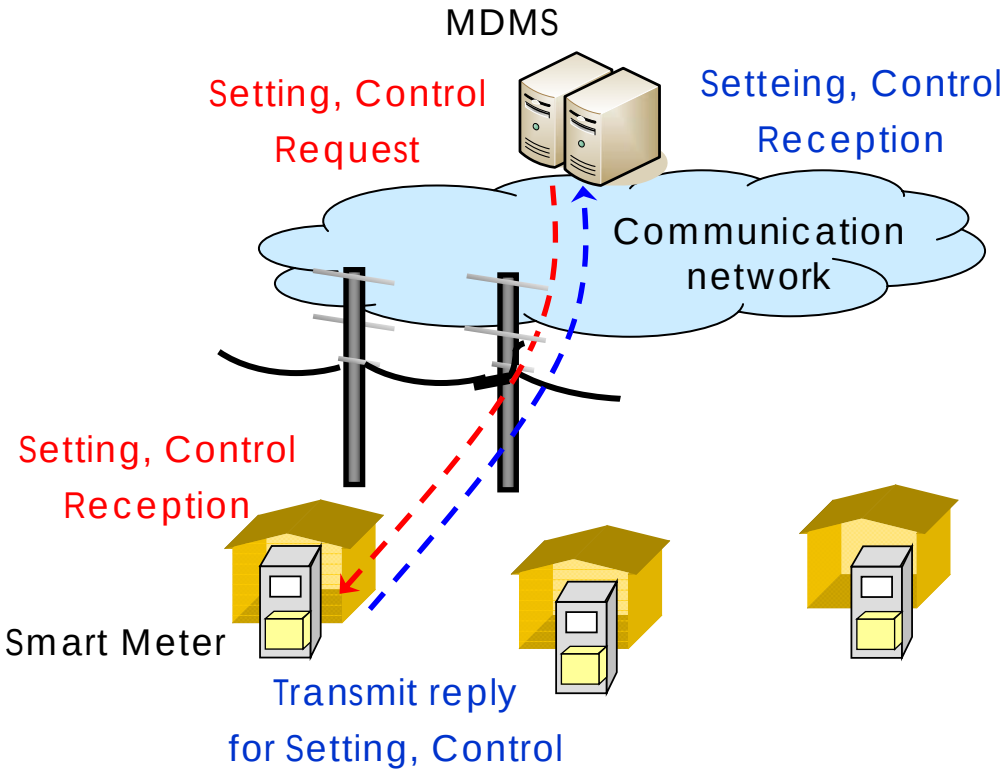
＜Figure of Service Image＞



Ⅱ-3. Functions of Smart Meter (6) - meter setting & control -

Not Modified

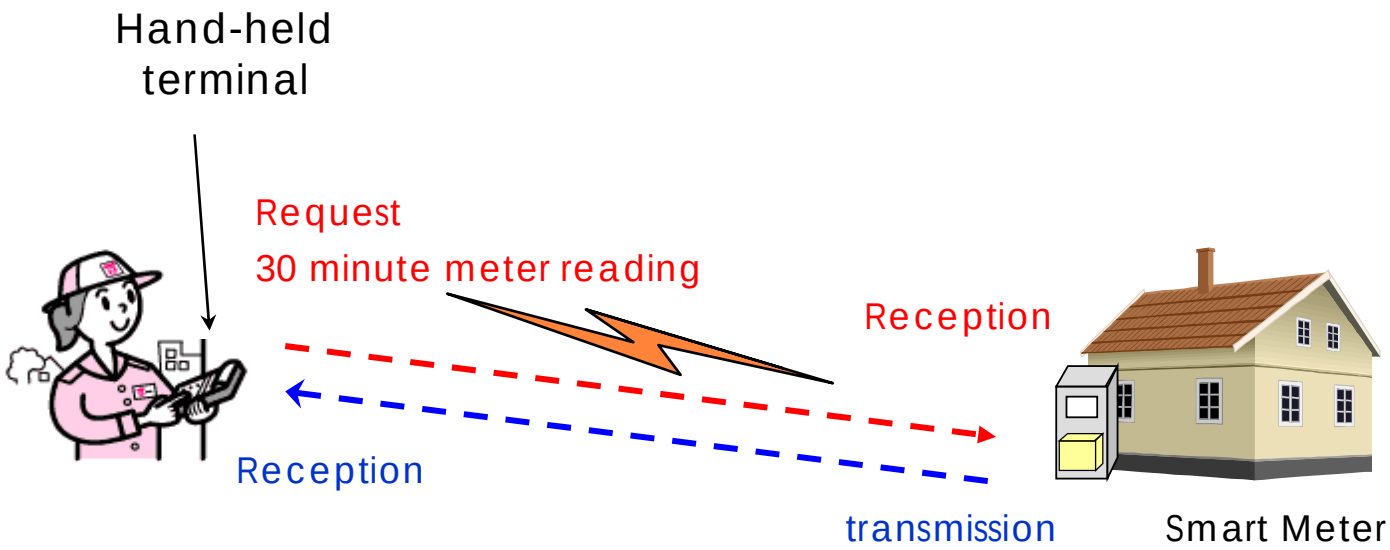
- The smart meter that received the setting and control request data for switch control and others from MDMS executes the requested process, and transmits the results to MDMS.



Not Modified

Ⅱ-3. Functions of Smart Meter (7) - Hand-held terminal communication -

- When communication via the communication network between MDMS and smart meter is not available, meter reading, setting and control can be performed directly by using hand-held terminal on site.



Not Modified

Ⅱ-3. Functions of Smart Meter (8) - Network Security -

■Smart meters deal with private customer information, which require assured security measures against the threats of illegal access, leaks or alteration of information and so on.

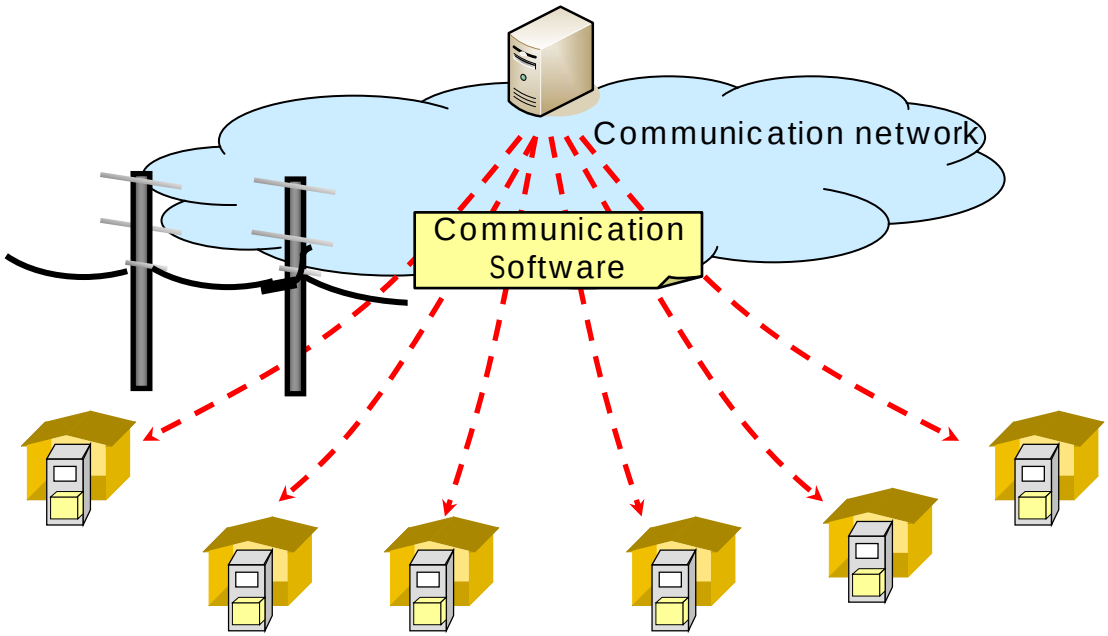
■Threats and countermeasures

Category	Specific Cases	Countermeasures
● Wiretapping	● Wiretapping in field area	● Encryption ● Regular updating of encryption key
● Spoofing	● Hacking	● Authentication ● Intrusion detection
● Alteration	● Altering in field area	● Packet alteration detection
● Intercepting	● Jamming of communication	● Monitor interference

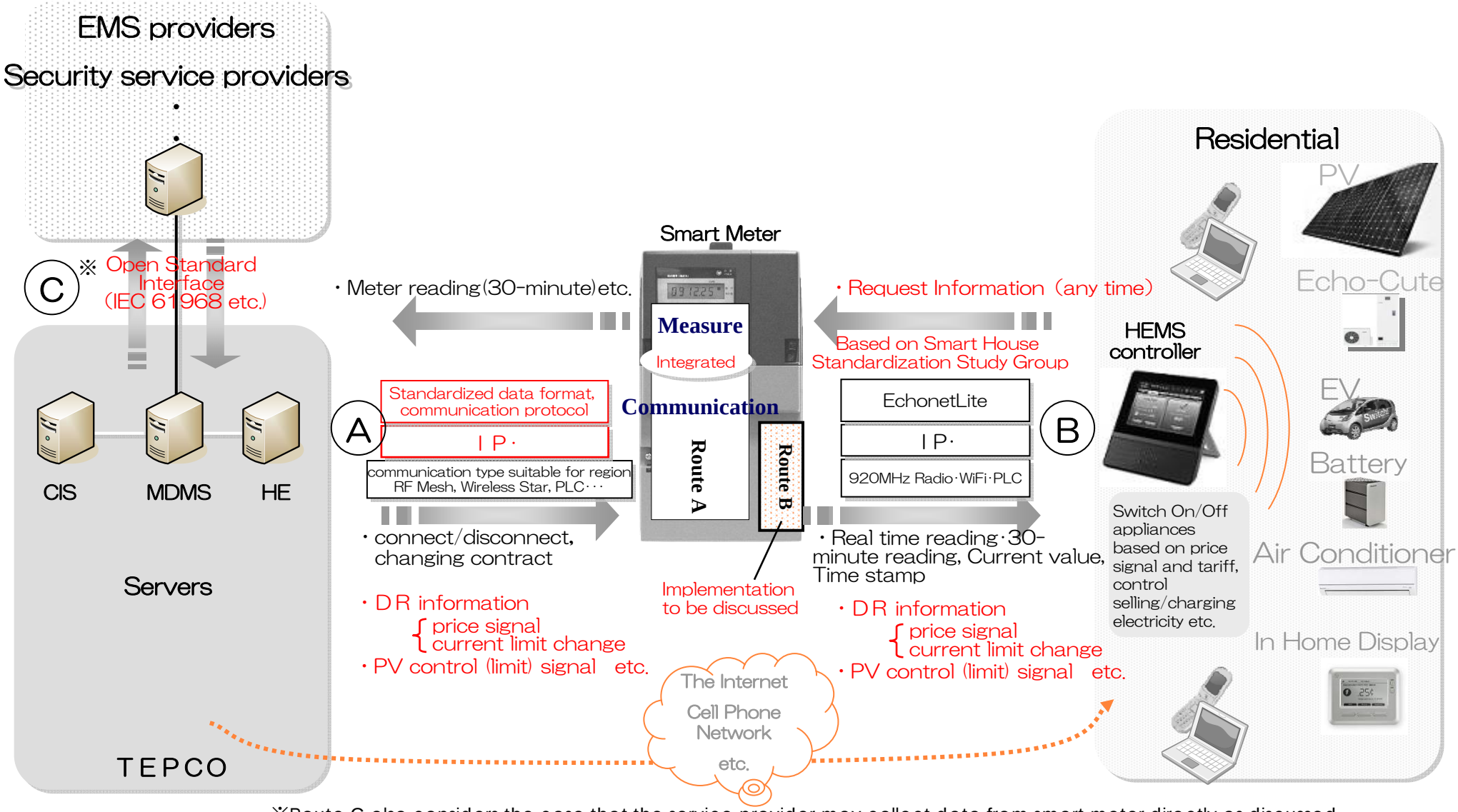
Not Modified

Ⅱ-3. Functions of Smart Meter (9) – Operation and Maintenance -

- To manage the large-scale network efficiently and accurately, smart meter automatically transmits facility management information to MDMS.
- To effectively improve the communication software of smart meter, function enhancement for future service and the countermeasure of security depression, the communication software is remotely updated using communication network.



<Reference> Overview for the Realized Functions (Objective Target)



※Route C also considers the case that the service provider may collect data from smart meter directly as discussed in The Study Group on the Smart Meter Scheme