# NEC's Cloud-Based HEMS Solution Advances with Data Utilization

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## Abstract

Interest in the Home Energy Management System (HEMS) has been growing as a technology for enabling energy supply-and-demand stabilization and greenhouse gas effect reduction. As a result of this trend, there is an increasing number of home appliances are implemented compatible with HEMS. NEC has been providing HEMS with visualization function and now is developing HEMS with enhanced capable of controlling household appliances. It is intended to link them to meteorological information as a future approach. This paper reports on our past achievements regarding HEMS application, its features and anticipated perspectives.

Keywords

HEMS, visualization, auto control, meteorology linkage, remote control, energy saving, energy-saving behavior, renewable energy, cloud computing, energy component

## 1. Introduction

At NEC, we began commercialization of Home Energy Management System (HEMS) equipment in 2011 and more than 40,000 HEMS units have been installed by 2015.

Full deregulation and liberalization of electric power retail sales to general households is scheduled for 2016. At the same time, energy suppression will become mandatory while the introduction of renewable energy systems is being encouraged. Such trends are tending to bring significant changes to the power supply market of general households. In consideration of a pressing need for compliance to the "Amended Energy Saving Act Standards" (a standard as of 2013) that will become mandatory for the housing industry by 2020, energy management of the entire household environment is now urgently required.

In this paper, we will review market situation that surrounds HEMS, describe approach taken by NEC toward HEMS in the past and discuss anticipated perspectives.

## 2. Situations Surrounding HEMS

It was in 2012 that the Smart House/Building Standardization and Business Promotion Study Group of the Japan Smart Community Alliance, established by Japan's METI, recommended ECHONET Lite as the standard interface between HEMS and home appliances. This step has rapidly accelerated promotion of dissemination of equipment that is compatible with both HEMS and home appliances. Introduction thereby has expanded in particular with the energy equipment known as eight key products: Smart Meters, photovoltaic power generators, storage batteries, fuel cells, EV/plug-in hybrid vehicles, air conditioners, lighting equipment and water heaters.

In FY2016, power system reforms are also to be advanced under the liberalization of power retailing for general households, as well as by deployment of Smart Meter installations and the previously opened route B communications (communications between the Smart Meters and HEMS terminals).

In addition to the trends described above, new services are expected to be accelerated by new power companies that utilize the energy data communicated

mainly via route B. Subsequently, studies and verifications aiming at utilization of energy data by HEMS will be boosted by enterprises that are participating in the "i-ENE Consortium".

On the other hand, renewable energy, particularly photovoltaic (PV) generation energy is expanding since the introduction of the fixed-price purchasing system. This has posed an important issue for power grid companies. In consequence, the power output of the renewable power generators has tended to be controlled more rigorously under the legislation that has resulted from the requests of the power companies.

Due to continual significant changes in the business environment, including those in the aforementioned legislation system, service providers and equipment manufacturers are advancing efforts to achieve stabilization of their power grid systems.

## 3. NEC's Approach to HEMS

At NEC, we are promoting the dissemination of ECHONET Lite-compatible energy equipment and progressing the deployment of the Advanced Metering Infrastructures (AMI) by introducing Smart Meters in the general households. Together with these activities, we are extending the visualization function of the equipment and enhancing their operation/control functions for their uses with other multi-vendor equipment. We have actually succeeded in implementing easier-to-install systems by means of the ECHONET Lite-compatible equipment. We have also achieved an installation environment that makes use of the power information readout of the Smart Meters and a flexible system configurations to the change of usage purpose.

Moreover, we have also linked the HEMS home terminals to the cloud computing and we are able to analyze the acquired home energy data in the cloud. In collaboration with our enterprise partners, NEC intend to expand the scope of our services to include power-saving advice, equipment surveillance and visualization of city's overall power consumption.

### (1) Approach to visualization

With our HEMS, power consumption of each branch circuit is computed in the cloud, so users can view graphs of purchased power, sold power, PV generation, recharging and discharging at a glance (**Fig. 1**). This trend has led to emphasizing power-saving awareness and has changed the behavior of the users.

HEMS is connected to various devices including: the ECHONET Lite-compatible Smart Meters, Smart Distribution panel, home stationary storage battery system and the Vehicle-to-Home-compatible EV charger/discharger. Multi-vendor equipment is thereby enabled to be integrated and visualized (**Fig. 2**). HEMS system may then be used as an effective household multi-monitor.

Fig. 1 Image of a top display.

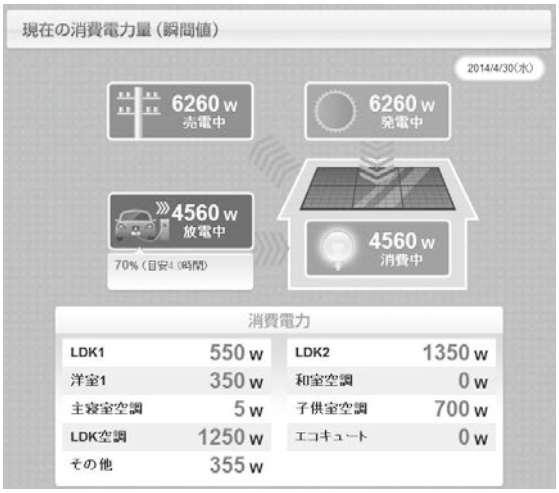


Fig. 2 Momentary power consumption value of an EV-connected system.

### (2) Linkage with equipment possessing various power metering functions

As a result of the opening of route B service by

power companies to households and the wide deployment of Smart Meters, equipment with power metering functions have been marketed additionally such as ECHONET Lite-compatible PV controller, stationary power storage system and Smart Power Distributor Panel. Thus, NEC's HEMS can control various facilities automatically to utilize generated energy more effectively. In order to detect failures of installed equipment and to facilitate efficient energy consumption, information is collected not only from the stock power metering device but also from new equipment mentioned above.

The standard method of power information collection from the Smart Meters via the route B communication is Wi-SUN standard, which is a 920 MHz band wireless communication standard. NEC's HEMS is compatible with this method by default and has actually acquired certification from the wireless section of the Wi-SUN Alliance and the SMA certification of the ECHONET Consortium.

**(3) Approach to equipment operation/control**

ECHONET Lite-compatible equipment such as air conditioners and household power storage systems can be controlled from inside the home using a PC or tablet, as well as from outside the home using a smartphone (**Fig. 3**). Each of such equipment has previously had to be controlled using its own remote controller, but currently, the innovative capability of controlling all of the equipment from a single terminal allows the user to reduce power wastage more easily and effectively than before.

HEMS also provides a function that automatically controls the operational settings of equipment after assessing environmental information, such as meteorological information. This function helps to meet the intention of the user (reduction of environmental load, improvement of economic balance efficiency) while not being consciously involved in applying the relevant control.

In addition, HEMS supports the user's energy-saving operations by optimally using cloud computing. It predicts the PV generation amount for the next day based on the weather forecast information.


Fig. 3 Web remote control
(Controllable from a browser).

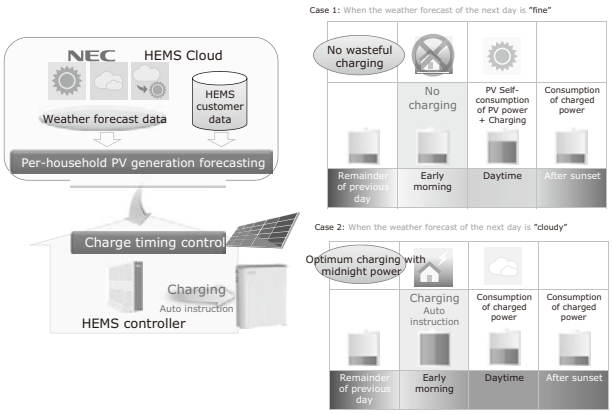


Fig. 4 Linkage between meteorological information and storage batteries.

Extra amount of power will be charged during the night when it expects that the PV generation will become insufficient for the next day power consumption. HEMS also generates an operation schedule for equipment that can reduce the need to purchase expensive daytime power for the same function. (**Fig. 4**).

**(4) Expansion of services utilizing data collected by the cloud**

The power data measured by the HEMS terminal of each household and the environmental information (temperature, humidity, etc.) collected by each item of equipment are collected and analyzed by cloud computation, in collaboration with business partners, those data is further utilized to provide new services to end-users. Specifically, it analyses the equipment usage situations and offers energy-saving advice based on comparison with similar households and also assesses the PV power generation status and the charge/discharge status of stationary storage batteries. The provided services include an equipment surveillance service capable of detecting failures, information on the users residing in houses and apartments, and visualization of an entire metropolitan area based on aggregation of a wide variety of information on commercial facilities, etc.

Each service is provided not only for the users but also for the persons in charge of the sales and maintenance of business partners. It thereby contributes to reducing their operating costs by simplifying sales and equipment installation tasks and reducing the maintenance and administration costs, as well as serving users by enhancing the value available to them.

## 4. Future Perspectives

As the reform of power supply systems and the introduction of renewable energies advance in the future, it is expected that power companies will progress the introduction of the "demand response (RD) system," with which consumers are requested to adjust their power usage behavior. This strategy aims to optimally implement their operations in accordance to their designated power supply configurations. Furthermore, it is also expected that an expansion of renewable energy supplies will also bring about requests for controlling the PV power output. In order to deal with such a trend and to minimize the loss of consumers without downgrading their comfort standards, we believe that it will be extremely important to quantify PV power generation and power demand requirements more accurately and by those means to control energy storage devices more optimally.

At NEC, we are determined to apply our big data analysis technology in this field so that we can contribute to the implementation of a safe, secure and comfortable society and everyday life by optimally controlling information and equipment via the collection and analysis of data supplied by HEMS. NEC's HEMS collects information from external environments such as meteorological information and from sensors installed inside and outside households. This is expected to increase in volume as a result of the dissemination of the IoT (Internet of Things).



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April 2016

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