Efforts Aimed at HEMS Solution

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Abstract

Interest in HEMS (Home Energy Management System) is growing as a technological solution to achieving energy supply stabilization and greenhouse gas reduction. NEC has been involved in the experimentation and verification of HEMS, such as measuring the impact of "visualization." Based on these results, NEC developed the HEMS Solution and began marketing it from July 2011. This paper introduces our efforts until now, the characteristics of the solution, and its future possibilities.

Keywords

HEMS, visualization, energy saving, energy saving activities, renewable energy
cloud computing, energy component

1. Introduction

As a countermeasure to environmental issues and the stressed energy supply following last year's earthquake, the need for energy saving and reduced power consumption by utility customers has become critical.

This being the current situation, attention is being focused on renewable energy and the spread of solar power generation systems is expected to accelerate in common households. However, even if renewable energy is increasingly adopted, it will be necessary for utility customers to be able to attain a stable energy supply by actively managing and flexibly controlling energy. One technological solution to these challenges is HEMS (Home Energy Management System). HEMS, which uses ICT (Information and Communication Technology) to enable unified management and control of energy used in the home, is expected to become an important elemental technology in formulating the energy companies of the future.

This paper will talk first about what NEC has achieved thus far in HEMS as well as the current challenges being faced by HEMS, followed by the characteristics of the system NEC developed and its future progression.

2. Achievements Up To Now

Here we will introduce the "visualization" effectiveness studies and analysis results that NEC Group has been involved in, as well as the current situation and challenges that face HEMS.

2.1 Results of Trial Service

We ran a trial service from April to June 2009 at around 100 of NEC Group employee homes involving the "visualization" of energy usage and CO_2 reduction, and measured its effectiveness.

The results of this trial service showed an approximately 10% reduction in power consumption, and approximately 15% reduction in CO_2. The questionnaire completed by participants showed that approximately 80% of them thought that the visualization service was effective in boosting awareness of energy conservation, and approximately 90% got a sense of saving energy (**Fig. 1**). Moreover, when asked about the motivation for continuing to use the service, the largest number responded "to regularly check daily energy usage through visualization."

From these results, it is apparent that "visualization" of

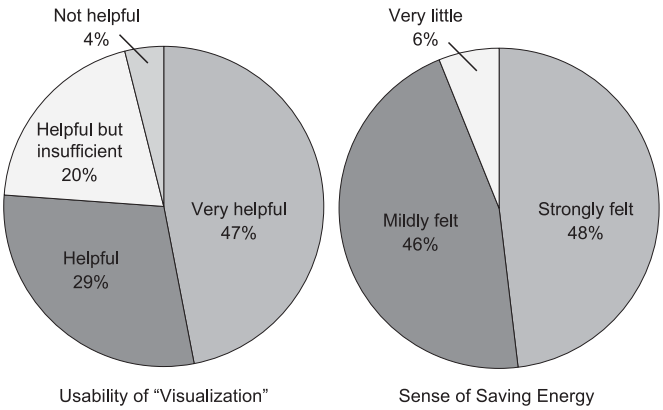

Fig. 1 Questionnaire results from "visualization" trial participants.

energy consumption and CO_2 reduction can play an important role in promoting the awareness and activity of energy conservation among users.

2.2 Situations and Issues Surrounding HEMS

A number of companies have marketed HEMS products, but up to now they have not spread substantially. One factor that may be impeding their spread is that the cost benefit is not apparent. The effectiveness, cost, and spread or HEMS are all closely related, and it is therefore necessary to show users that there is a monthly energy cost benefit that offsets the initial cost of purchase.

Another factor contributing to sluggish growth is that, depending on the system, the products that can be managed by HEMS may be limited to a certain brand. In most households, it is common to see home electronics and appliances by various manufacturers being used. At present, many issues need to be resolved prior to managing products of multiple brands by HEMS, including not just the standardization of the communication interface, but also security and maintenance issues spanning different manufacturers. In order to resolve these matters and address issues of standardization, the "HEMS Alliance" has been set up with the cooperation of a number of companies, including NEC.

3. Future Progression of HEMS Solution

NEC has developed an HEMS Solution, aimed at further promoting the spread of HEMS, and based on the study results and challenges described earlier. Due to the widespread prevalence of PCs and other internet-connected display devices in households, we designed a system that does not require a dedicated monitor, which led to lower cost.

Moreover, by measuring the electricity data from the distribution board circuit, it achieves "visualization" regardless of the manufacturer of the electrical appliance or the distribution board used in the home. And since it can be installed in both new and existing buildings, it is easily and flexibly adaptable into a wide range of residential environments. In the following section we will discuss the system framework of our HEMS Solution and its characteristics.

3.1 System Framework

In this system a power measurement device is placed near the power distribution unit of the home, and a Current Transformer (CT) measures the amount of electrical current. The measured current amount is sent as electricity data to the information collection device, stored there temporarily, then

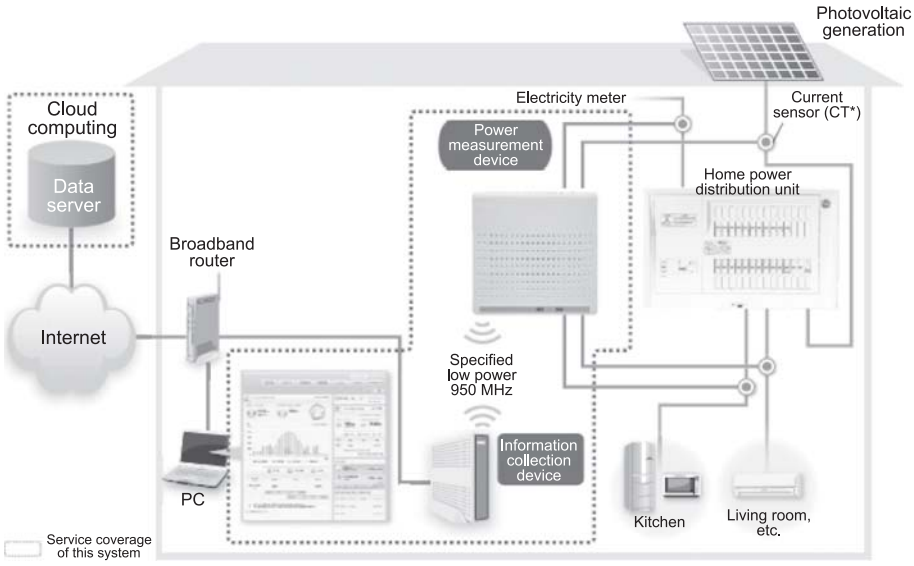

Fig. 2 HEMS system framework.

sent to the cloud server. Using an Internet-connected home PC or other device, the HEMS user can browse data screens to check power consumption, power generation, and energy cost, that have been compiled, analyzed and "visualized" by the server (**Fig. 2**).

The in-home system is comprised of a power measurement device and information collection device, and since a versatile terminal such as a PC is used, there is no need for a dedicated monitor. In this way, initial cost can be minimized.

3.2 System Characteristics

(1) Easy-to-understand information display

The electricity information sent to the cloud-based data center is tallied up as the power consumption for the current day, or by date, month, year, or branch circuit, and is displayed in graph form. As a result, it will be possible to understand the trends of power consumption over time (**Fig. 3**).

Moreover, the estimated power utility charge based on power consumption will be displayed. This is calculated by enabling the cloud to manage the basic information regarding power rates by different power utility companies, per type of account, and figuring in seasonal and time rate variables. The user does not need to make any complicated settings; all that is required is to select the power utility company and type of account, and the utility charge can be checked. By enabling the user to understand his power consumption more intuitively, this system can contribute to promoting increased energy-saving awareness.

(2) Highly versatile installation environment

Since this system uses a CT (Current Transformer) sensor to measure electrical current, it can be installed in new and existing homes, regardless of the manufacturer of the power distribution board in the home. And since electrical data is measured at the power distribution board, the system can be used regardless of the specific type or manufacturer of home appliances and equipment existing in the home.

The power measurement device communicates to the information collection device by transferring data wirelessly via specified low power radio signal. The system thus suffers very little interference from microwave ovens and wireless LAN equipment, enabling it to be installed with a high degree of location freedom.

(3) Measurement and display for distribution board's main and branch circuits

By acquiring electrical data at the power distribution board, it is possible to measure the power consumption for electricity from the power grid, for solar power generated electricity, and for each branch circuit (up to 8) as well.

As a result, it is possible to calculate and display the amount of electricity generated by the solar power system, electricity bought from the power utility company, as well as sold back to the power utility company. Furthermore, it is possible to display the power consumption per each branch circuit division, such as each room or each appliance (**Fig. 4**).

Fig. 3 Example of information display top screen.

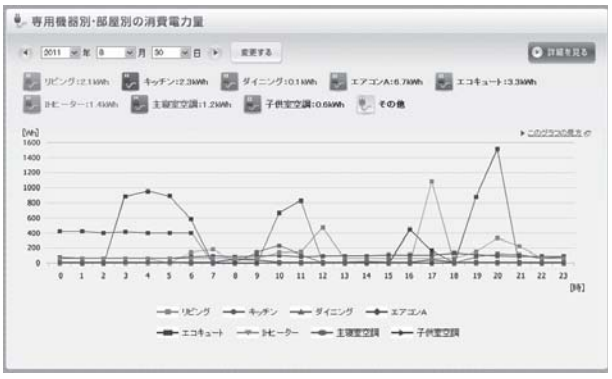

Fig. 4 Example of power consumption breakdown display screen.

(4) Cloud type system framework

By adopting a cloud-based system architecture, all electricity data sent from each household is gathered and accumulated in the cloud. This architecture allows service providers to utilize and analyze the accumulated data. Based on accumulated information such as gathered data and user attributes, it will be possible to offer additional services like energy consumption trend analysis and energy-saving consultancy. This may in turn provide users with the opportunity to implement energy-saving activities and heighten their awareness of energy matters.

Furthermore, when it comes to revising or expanding an application or content, most of it can be handled from the cloud side. So it will be relatively easy to offer new services to users.

4. Future Efforts

We believe that smart house design will become increasingly popular and energy use will become more sophisticated, progressing simultaneously as new energy components spread rapidly and are used effectively, such as power producing devices including solar power generating systems and fuel cells, as well as energy storage systems and electric vehicles (**Fig. 5**).

In order to effectively use such energy components, they must first be integrated and managed. In terms of allowing products by multiple manufacturers to be inter-operated, various problem-solving steps are being taken including the aforementioned HEMS Alliance as well as standardization discussions in both the public and private sector. NEC is actively participating in these activities to help meet various challenges.

Furthermore, as the increased burden on the electrical power supply continues, procedures for equalizing the use of electricity become necessary. In such cases, we may see an increased implementation of so-called “demand response” measures, such as power companies asking users to curtail electricity usage during peak hours, or applying a variable rate system.

We will continue to expand the functionality of our HEMS solution in the future, keeping these conditions in mind.

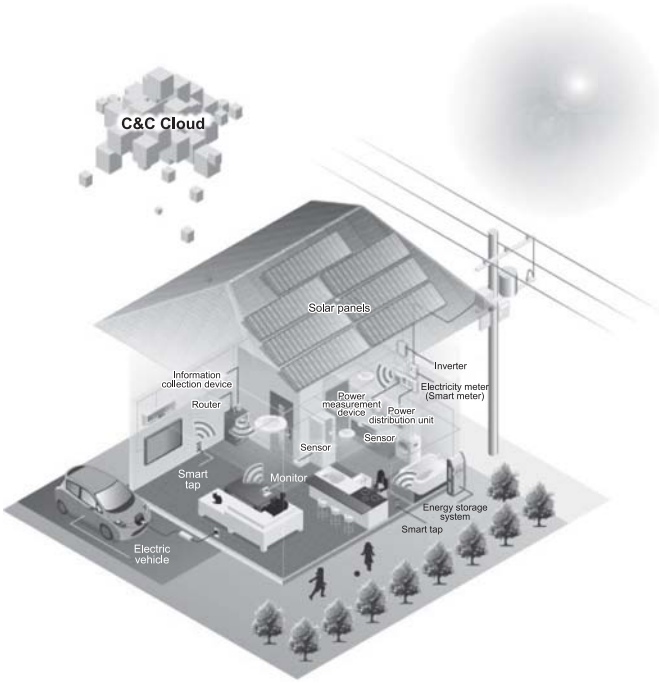

Fig. 5 Smart house image.

5. Conclusion

In this paper we introduced our efforts regarding HEMS until now, the characteristics of the developed HEMS Solution, as well as what we intend to do in the future.

NEC intends to contribute to solving environmental issues through promotion of efficient energy usage as a result of our providing and spreading the HEMS Solution utilizing ICT and cloud computing technologies.

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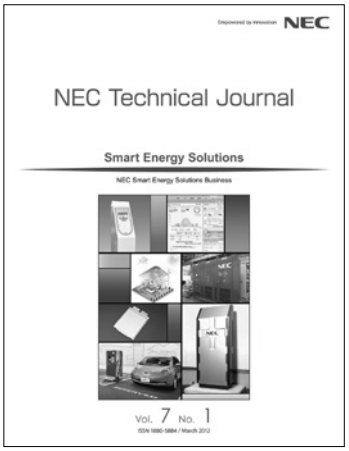

Vol.7 No.1
March, 2012

Special Issue TOP