xEMS the Energy Management System with the Best Use of M2M

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Abstract

Energy policy in Japan is now in a major transformation phase. This is due to the current trend in the rapid dissemination of solar photovoltaic (PV) power generation and electric vehicles (EVs), and also to the need to review nuclear power generation resulting from the recent Great East Japan earthquake disaster. In the future it will be more practical to control our electric power system balance more precisely by changing society and encouraging "electricity generation at the point of use" rather than by "purchasing ever increasing amounts of electricity from the electric power companies." NEC is developing innovative EMSs to achieve an energy conscious society in the next generation. It is also optimally using the technologies that have been accumulated from our long-term experience in supervisory control system solutions for social infrastructure facilities. Our service platform technologies such as M2M and cloud computing engineering are also being expanded. This paper will introduce our approach to these developments.

Keywords

EMS, energy management system, smart grid, supervisory control system, M2M, cloud computing, BCP

1. Introduction

After experiencing the recent Great East Japan Earthquake, we have re-recognized how important is the "stable supply of electricity." It is an essential requirement for achieving safe and agreeable day to day living conditions. At the same time, the environment surrounding energy management systems is changing significantly. New energy devices such as photovoltaic cells (PVs), electric vehicles (EVs), and rechargeable batteries for household-use are being rapidly disseminated. User awareness regarding electricity issues has been changed by our recent experiences of planned power outages and orders to save electricity.

NEC has been constructing a variety of supervisory control systems aimed at social infrastructures. We have now accumulated abundant expertise and have developed significant high-level technologies in these fields. We are therefore ready to optimally use these technologies in support of these new trends in society.

In Section 2 of this paper we outline features of the present power supervisory control system that is equipped with the exclusive M2M technology. In Section 3, details of the next-generation energy management systems are described. These include PV and rechargeable batteries for adding exclusively to the standard features and concepts of M2M solutions. In Section 4, we introduce an xEnergy Management System, xEMS that is currently under development.

2. Outline of the Exclusive M2M System – Electric Power Supervisory Control System

It is essential to consider the balance between "supply" (power generation volume) and "demand" (power consumption volume) in order to achieve stale power supply. The "demand" of electric power varies by season, weather and time of day. Once the balance is exhausted, serious events such as power outage, frequency deviation, etc. may occur. To prevent such adverse events, electric power companies construct electric power supervisory control systems in order to confidently control the power generation volume at power stations, while also being aware of the power consumption volume, which changes every moment.

Current Electric Power Supervisory Control Systems

An example of the current system used in power supervisory control is shown in **Fig. 1** .

Central computers are installed to monitor main power stations and substations and to provide requisite controls. NEC's DX unit (Data exchanger: information collection and

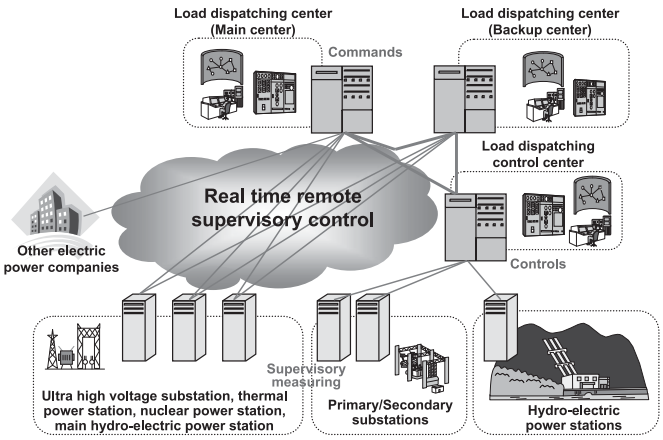

Fig. 1 The current electric power supervisory control system.

distribution unit) and a smart remote supervisory control unit are performing significant roles in the speedy and secure transmission of monitored and controlled information between computers and the electric power stations, including both main and sub stations.

The information to be transmitted between the systems is mainly for supervisory, calculating and controlling data. This data is bit rate data such as “0 = switching off” and “1 = switching on,” which is very important information. Therefore, it is essential to achieve the following points.

1) Prevention of omitting information
2) Securing regulation responses
3) Prevention of faulty information transmissions
4) Ensuring security
5) Efficiency of maintenance management

To achieve the above points, NEC has developed the “RISAC” series (**Fig. 2**) as an exclusive M2M system featuring high reliability and security for long term use. We have also upgraded and expanded our product lineups to meet our customers’ needs.

The RISAC series is a component for supervisory control systems that features superior hardware performances. It adopts an architecture that has no movable parts such as hard disk drives, cooling fans, etc., and it is capable of high reliability and high performance of distribution processing as well as high versatility in coping with the demands of the severe usage environments of electric power stations. NEC also possesses various protocol procedures such as IP, complicated packet processing, etc. These advantageous software assets enable us to construct efficient and high quality supervisory

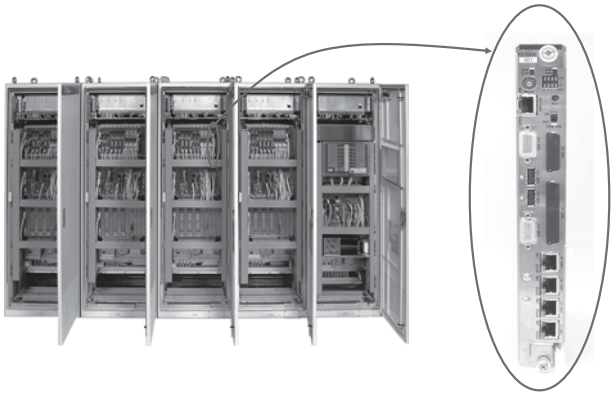

Fig. 2 Standard DX unit and RISAC series.

control systems. Moreover, such systems are adopted not only for electric power supervisory control systems but also for a wide range of NEC’s social infrastructure systems.

3. Progress toward a Comprehensive Energy Management System

The dissemination of various energy generation facilities: PVs, rechargeable batteries, EVs and home power generators has changed the flow of the power supply from what used to be a one-way flow from an electric power company to the user. However, users will have the chance to generate and store energy more generally in future, so that in consideration of such trends a comprehensive energy management system will be anticipated as a standard solution.

NEC assumes that much higher reliability and maintainability will be demanded for the electric power networks, for which we have been leading the market. We intend to deal with these demands by further advancing features of the exclusive M2M system.

On the other hand, NEC’s standard M2M solution “CONNEXIVE” is approved for employment as a countermeasure for a comprehensive energy management capability that targets facilities installed inside users’ buildings. This is because the types and numbers of target facilities will increase significantly and secure mutual connectivity and cost competitiveness and thereby become more important factors in a comprehensive energy management policy.

The exclusive M2M system will be applied in the domains for which higher reliability and capability are expected, and “CONNEXIVE” will be exploited for providing new services

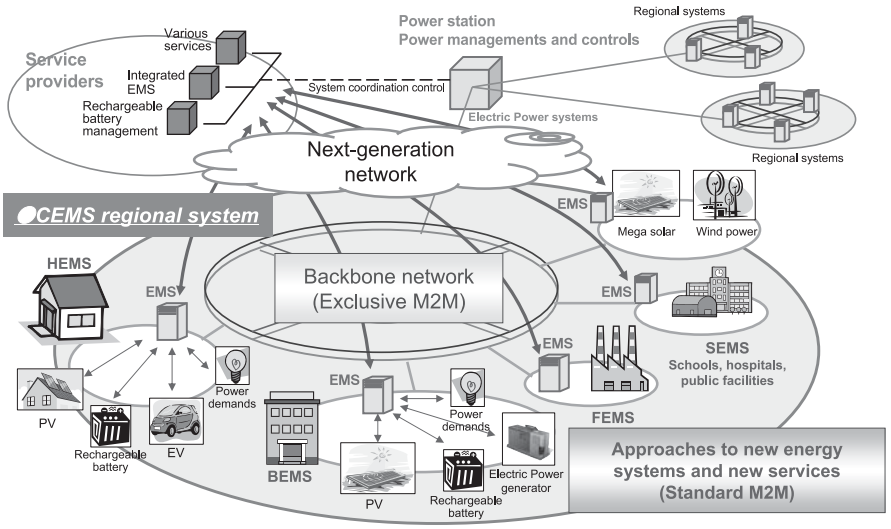

Fig. 3 Next-generation energy management system.

that combine PV and new energy data, and also for the transmission of maintenance information. NEC will construct flexible and integrated systems, not only for conventional electric power companies but also for new markets including those in the wider commercial fields.

A diagram outlining the next-generation energy management system that NEC is achieving is illustrated in **Fig. 3** .

Terminology used in the figure is also defined.

- **HEMS : Home Energy Management System**
- **SEMS : Store Energy Management System**
- **BEMS : Building and Energy Management System**
- **FEMS : Factory Energy Management System**
- **CEMS : Community Energy Management System**
- **M2M:**

Telecommunications between xEMS and a large number of energy components. At the same time, telecommunications between xEMS and upstream service providers which plan using the cloud computing services.

- **Cloud computing:**

Integrated control of system coordination, PV control, management/maintenance and energy component management.

4. xEMS Domains that NEC Targets as Social Infrastructure Systems

NEC develops supervisory control systems not only for electric power companies but also for a wider range of social infrastructures including dams, rivers, water supplies and sewerage systems, railways, roads and buildings.

We are promoting various EMS related developments that will accelerate new energy projects in such social infrastructure domains.

4.1 EMS Related Products

EMS systems equipped with BCP function are introduced in this section as one of the EMS related products supporting social infrastructure systems that are expected to employ M2M cloud computing.

The system is assumed to be installed in buildings of middle-sized users including office buildings, factories, schools, etc. It achieves savings of energy and electricity on a routine basis as well as providing a “Business Continuity Plan” (BCP) as a countermeasure to disasters and planned outages.

(1) System configuration

The system consists mainly of an EMS, a BCP power distribution board, a M2M cloud computer and sub power units (PV, stationary rechargeable battery and emergency power supply unit). EMS achieves the optimum energy management by controlling: 1) energy supply units including commercial power supply, PV and a rechargeable battery, 2) device loads status, 3) information dispatched from M2M cloud computers and 4) various settings information. The BCP power distribution board measures and visualizes electric power usage and also performs smart controls that

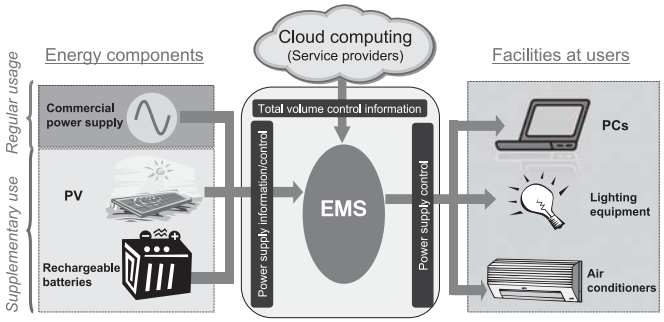

Fig. 4 Conceptual scheme of an EMS equipped with BCP functions.

correspond to load priorities as emergency countermeasures, so that users will be secure by having a BCP (business continuity plan). The conceptual scheme of the EMS system equipped with the BCP function is indicated in **Fig. 4** .

(2) Functions

1) Visualization of electrical power usage

The power usage status of the electric power system (per circuit breaker of the BCP power distribution boards) and the system configuration device status are displayed on the console screen. The status of the BCP power distribution circuit is also displayed.

2) Power load control

Power systems divided per BCP power distribution board are controlled according to power usage conditions such as energy saving mode or planned outage situation, etc. They are switched ON or OFF according to load priorities. These controls can be carried out manually on the console screen, or they may also be set to the automatic control mode.

3) Cloud computing services

The EMS equipped with a BCP function maintains linkages with external systems. This arrangement achieves energy management in conjunction with local area cloud computing services. However, it is also capable of acquiring RTP (Real Time Pricing) information and calendar information that is used to solve the surplus power problem in holidays. Moreover, this system is expected to be employed for various other applications including the service life control of rechargeable batteries and their remote support services, etc. NEC aims to continue to expand the system functions.

4.2 Future Approach

An xEMS experimental facility is planned to be constructed at the NEC Fuchu Plant from late in FY2011 in order to intensively install PVs, rechargeable batteries and various energy management systems. The xEMS experimental facility is expected to play a significant role by providing an important base for the further research and development of NEC’s smart grid technologies and also for performing evaluations of the M2M and cloud computing technologies.

5. Conclusion

This paper introduced a conceptual outline about the next-generation energy management system that integrates the high performance M2M technologies accumulated during our research and exclusively aimed at social infrastructure systems into the standard M2M solution “CONNEXIVE.”

Energy policy in Japan is facing a radical change due to world-wide requests for reductions in CO_2 emissions, and also as a result of our experiences due to the recent nuclear power station accident. In a society that encourages the use of natural resource energy supplies, rechargeable batteries and EVs and in which such systems are commonplace, their importance in changing social infrastructures is to be expected.

NEC will contribute to achieve a safe and pleasant society by promoting more cutting edge technologies and by providing energy management systems that match the issues of the era.

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