Part 01

Developing Techniques for Monitoring Battery Operations

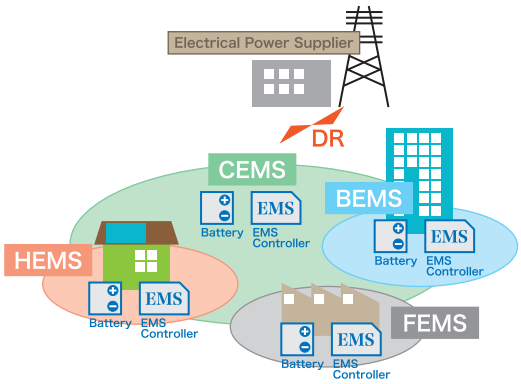
Charging and Discharging the EMS Storage Battery

An Energy Management System (EMS) uses information communication technology to balance electrical demand and supply. The EMS has grown rapidly in recent years. A device equipped with a storage battery (storage-enabled devices) plays an important role in the EMS.
For many years, GS Yuasa has manufactured and sold the storage batteries and storage-enabled devices which have been critical to the growth of energy management systems. Many of our products are operating in a variety of buildings, factories, homes, and communities. This article will explore the network devices used to implement regular monitoring of storage-enabled devices, and will introduce how the charging and discharging of the storage battery can be controlled via a network card.

1. The EMS and the Storage-Enabled Device

An 'energy management system' generally refers to a system that collects data, constantly monitors, and simultaneously makes automatic adjustments to a control parameter within an energy network, e.g., the voltage or frequency. Recently, the EMS for buildings, factories, homes, and communities are being referred to as Building Energy Management Systems (BEMS); Factory Energy Management Systems (FEMS); Home Energy Management Systems (HEMS); and Community Energy Management Systems (CEMS)[1]. An EMS controller is provided for each of the different management domains. The EMS controller accounts for demand response requests which initiates conservation according to the state of electrical power while managing the electrical power available in its management domain (●Fig. 1).

●Fig. 1 Different domains managed via an EMS



A storage-enabled device such as an industrial battery system or an uninterruptible power supply (UPS) adjusts the balance of energy demand and supply within the EMS. More specifically, the storage-enabled device may charge or discharge the storage battery to perform load-leveling (i.e., peak shifting or peak shaving) and to reduce the gap between daytime and nighttime demand and supply, or to suppress power usage when power is in short supply.

2. A Network Card Designed for EMS

In 2014, GS Yuasa released a network card developed specifically for use in an EMS that operated and monitored storage-enabled devices[2], the Acroware-iGYnetworkAgent (●Fig. 2).

●Fig.2 GS Yuasa Acroware-iGYnetworkAgent

Monitoring the traditional storage-enabled device was primarily for providing concrete data on the state of a device based on measurement of power in and out, power outage detection, storage battery capacity or voltage, temperature, or device malfunction.

Developing the network card grew out of the realization that a storage-enabled device used in an EMS needed to do more than simply provide backup power. More specifically, a storage-enabled device needs to have a variety of high-level functions allowing for the device to be repeatedly charged and discharged according to power demand and supply. A network card mounted in a storage-enabled device can communicate with the EMS controller and allow various high-level functions to be implemented (●Fig. 3).

The Acroware-iGYnetworkAgent comes equipped with the traditional monitoring function, the standard HEMS protocol to support an EMS, i.e., ECHONET Lite, and a peak shifting function for use with an uninterruptible power supply. Therefore, in addition to being able to provide concrete information about the storage-enabled device, the network card also supports efficient power control.

3. Distributing and Updating the Charge-Discharge Algorithm through the Network Card

Given that the EMS controller executes tasks for precise control of a load device such as an air conditioner or lighting, adding tasks that control the charging and discharging of the storage battery would increase the processing load. This trend is quite apparent especially when the EMS controller coordinates many storage-enabled devices within its management domain.

One approach is to have the charge-discharge algorithm stored on a power management server in advance, and to distribute this algorithm to the network card in the storage-enabled device when certain conditions are met. That way, the network card can take on charging and discharging control tasks, thus reducing the load on the EMS controller. For example, the power management server may distribute a new charge-discharge algorithm to a network card through the EMS controller when changes in the operation of an air-conditioner changes the power supply or demand.

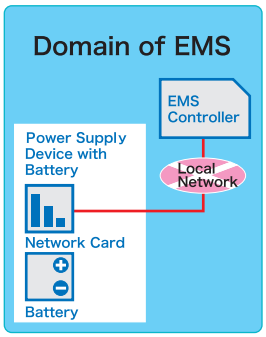
At this point, the network card determines whether or not it is possible to run the newly distributed charge-discharge algorithm (S1, ●Fig. 4). If it is possible to run the algorithm, the network card controls the charging and discharging of the storage battery according to the algorithm (S2, ●Fig. 4).

However, there are cases where the algorithm that is distributed cannot be used for charging and discharging as planned; this may depend on the state of the storage battery, e.g., the state of charge (SOC). In such cases, the network card sends the EMS controller the reason the algorithm cannot be executed and requests a modified algorithm (S3, ●Fig. 4). The EMS controller, in turn, requests that the power management server distributes a modified charge-discharge algorithm (S4, ●Fig. 4). Note that the EMS controller may act as a data processor for the power management server.

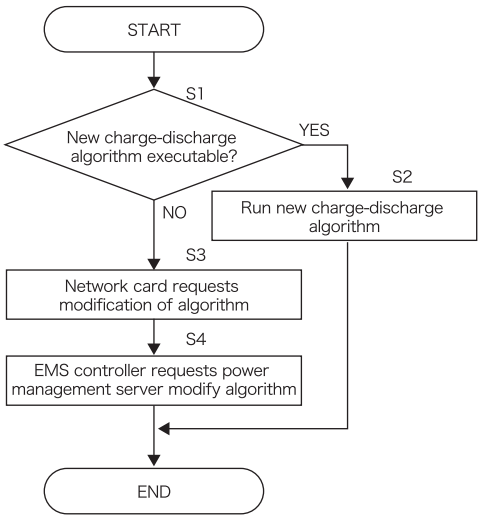
Thus, ensuring that the network card can initiate a routine to update the charge-discharge algorithm does not increase the load on the EMS controller. Moreover, providing this function in the network card allows the storage battery to operate according to the type of EMS. This improves safety and stability when operating the storage battery.

This article explored the use of network devices to implement regular monitoring of storage-enabled devices, and discussed how the charging and discharging the storage battery can be controlled via a network card. Part Two of this series will introduce how a network card can improve the efficiency of the maintenance task.

●Fig. 3 Concept Image: Storage-Enabled Device for Use in an EMS



●Fig. 4 Procedure for updating the charge-discharge algorithm[3]



1. Energy Management for Smart Communities, Smart Grid Editorial Board (Compilation), 2016, Taiga Shuppan
2. GS Yuasa Technical Report Volume 11, No. 2, published 2014
3. Japanese Patent No. 6402924 (Filed in 2014)

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