Equipment Monitoring System "MICREX-VieW PARTNER" Easily Cooperating with Integrated EMS

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ABSTRACT

In conjunction with the expansion of the energy management system (EMS) market, an equipment monitoring system is capable of further growth as an infrastructure system that implements optimal operation and connects an EMS with actual equipment. Our recently developed equipment monitoring system "MICREX-VieW PARTNER" comes standard with engineering tools and functionality for cooperating with an integrated EMS. The system also makes it possible to minimize introduction cost and time when implementing the cooperation with the integrated EMS. In addition to its standard functionality, it also comes equipped with a schedule control function, demand monitoring function and customization function based on a simple language, thus making it compatible with various types of equipment.

1. Introduction

With the increasing demand for energy saving (energy conservation) in recent years, an optimal operation planning function has been attracting attention and its application is increasing(1)(2) as well as conventional energy management systems (EMSs). While EMSs are mainly designed to visualize energy, the optimal operation planning function is intended to make and control an operation plan for utility equipment based on energy supply (generation) prediction and demand prediction. In conjunction with the expansion of the EMS market described above, an equipment monitoring system is expected to grow further in the future as an infrastructure system that implements optimal operation and connects an EMS with actual equipment.

Fuji Electric has developed and provided an integrated EMS that integrate energy visualization and energy-saving controls in various business sectors including steel, general industry, store distribution, water treatment and regional communities to provide energy management functions(2). We also had been developing the "SIRIUS" and the "Partner IT" until 2009 and have been developing the "Partner Σ" since 2010 as equipment monitoring systems and offered them to our customers. Recently, however, there are increasing demands for ways to handle issues that are difficult to handle with Partner Σ, such as EMS cooperation.

This paper describes the equipment monitoring system "MICREX-VieW PARTNER" that can easily cooperate with the integrated EMS. This is a newly developed system based on enhancing Partner Σ. It inherits the screen operation and engineering procedures of the monitoring and control system "MICREX-VieW XX (Double X)" and supports the Internet of Things (IoT) and security to which increasing attention has been placed in recent years.

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2. Development Background

In typical plants, independent equipment monitoring systems exist on the consumption side (demand side) and on the energy production and supply side (supply side) respectively. If these systems are optimized individually, losses are generated from the process of adjusting the balance between supply and demand. This often results in insufficient energy saving in the entire plant. On the other hand, when an integrated EMS is placed at a higher level and the equipment monitoring systems of the supply side and demand side are cooperated with the integrated EMS, an optimal balance is achieved between supply and demand, allowing maximum energy saving in the entire plant. This, however, requires significant labor and cost especially for implementing the cooperation between the integrated EMS and the equipment monitoring systems. This is because different communication methods and engineering environments are used for individual equipment monitoring systems so that every cooperation between an integrated EMS and an equipment monitoring system requires creation of a separate complete application in accordance with each case.

Against this background, Fuji Electric has developed the equipment monitoring system "MICREX-VieW PARTNER" that can easily cooperate with the integrated EMS (see Fig. 1). In addition to standard functionality such as monitoring, trend, reporting and alarm monitoring, it is equipped with a schedule con-

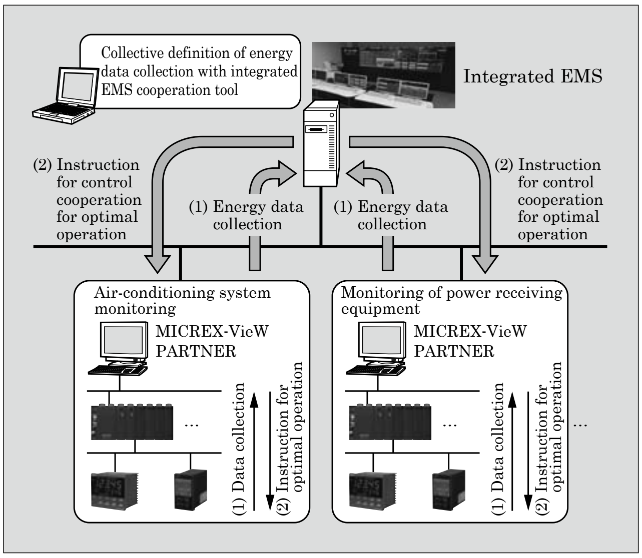

Fig.1 System cooperation between an integrated EMS and "MICREX-VieW PARTNER"

trol function, a demand monitoring function and a customization function based on a simple language, and can be used in common for various types of equipment.

3. Overview of "MICREX-VieW PARTNER"

Figure 2 shows the system configuration of MICREX-VieW PARTNER.

One server set can be installed within the system. In a duplicated configuration, one set consists of 2 servers. Moreover, a client function can be added to the server to use it as a standalone configuration.

Up to 14 computers can be installed in the system as clients. When a client function is added to each of the servers in a duplicated configuration, the maximum number of clients will be 16.

The controllers are connected to the server via a control LAN and up to 30 controllers can be installed.

The control LAN is an Ethernet*1 network connecting the servers and controllers. The inter-system LAN connecting System A server and System B server is an Ethernet network used for providing redundancy and equalizing data between the servers. The information LAN is an Ethernet network used for communicating between the servers and clients and for cooperation with other systems.

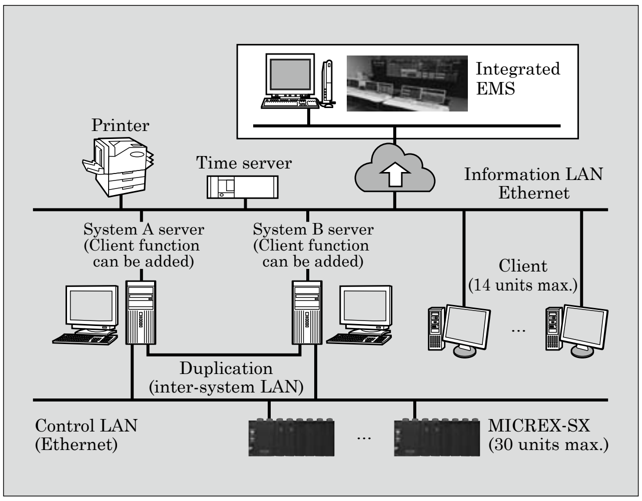

Fig.2 System configuration of "MICREX-VieW PARTNER"

The major specifications of MICREX-VieW PARTNER are shown in Table 1 and its screen types and functions are shown in Table 2.

Table 1 Major specifications of "MICREX-VieW PARTNER"

Item		Specification
Number of tags (quasi-instruments)		20,000
Message recording		365 days or 365,000 messages
Trend recording	Maximum number of recording*	○ 60-second cycle: 10,000 records ○ 5-second cycle: 5,000 records ○ 1-second cycle: 500 records
	Sampling frequency	○ 1 second to 1 hour
	Storage period	○ 3 years (60-second cycle) ○ 3 months (5-second cycle) ○ 7 days (1-second cycle)
Reporting	Maximum number of recording	○ Daily report: 10,000 ○ Monthly report: 10,000 ○ Yearly report: 10,000
	Storage period	○ Daily report: 10 years ○ Monthly report: 10 years ○ Yearly report: 10 years

* When status change of 60 records/30 seconds is continued

Table 2 Screen types and functions

Screen	Function
Group screen	○ To list instrument graphics corresponding to the monitoring items in the controller. ○ To arrange and edit instrument graphics displayed on the screen.
Tag menu screen	○ To display one page of the group screen as one symbol and then display the integrated list of the statuses/values of the monitoring items on each page.
Loop screen	○ To display the parameter settings and values of quasi-internal instruments corresponding to the monitoring items.
Integrated history screen	○ To display a list of alarm messages and operation messages together.
Trend screen	○ To display the trend of measurement data.
Annunciator screen	○ To display a list of abnormalities occurring in the equipment.
Report screen	○ To display and edit daily, monthly and yearly reports.
Plant screen	○ To monitor and operate each equipment.
Schedule control screen	○ To set the operation/shutdown schedule according to the seasons, the day of the week, or a specific day or period on the calendar.
Demand monitoring screen	○ To set the value or schedule required for demand monitoring and perform monitoring.

*1: Ethernet: Trademark or registered trademark of Fuji Xerox

4. Features of “MICREX-VieW PARTNER”

(1) Easy cooperation with an integrated EMS

An integrated EMS conducts real-time energy-saving operations in accordance with the energy management and current operation condition of the entire plant. It thus needs to closely cooperate with multiple equipment monitoring systems installed inside the plant to manage operations. To implement such cooperation easily, MICREX-VieW PARTNER comes standard with engineering tools and functionality for cooperating with an integrated EMS.

The details of the cooperation with an integrated EMS are shown in Table 3. The conditions of all equipment managed by MICREX-VieW PARTNER are shared with and can be controlled by the integrated EMS in real time.

Users can use the engineering tools to notify the integrated EMS of aggregated data by just defining the energy collection cycle for each tag. As a result, the integrated EMS can easily build an energy-saving management system covering the entire plant.

(2) User-friendly design

The high-reliability, high-screen-operability including multi-window operation and universal design[3] of MICREX-VieW XX have achieved user-friendly operations.

(3) Use of quasi-internal instrument tags

In conventional equipment monitoring systems, tags are assigned to each of the monitoring and control points such as digital input (DI), digital output (DO), analog input (AI) and analog output (AO). Consequently, the association of AI with AO or the association of DI that manages control lock information with DO is established through engineering work.

For MICREX-VieW PARTNER, the collection of related DI, DO, AI and AO is represented as one quasi-internal instrument tag and implemented within the server as standard. The quasi-internal instrument tags consist of 6 types covering 90% or more of the tags used in the conventional equipment monitoring systems (see Table 4). This greatly improves the efficiency of engineering work. Tags that cannot be consolidated into any types can be used as independent ones in the same way as conventional tags.

Each monitoring and control point consolidated into the quasi-internal instrument tags is identified with a tag name concatenated with a period and an attribute name such as “Tag name. PV.” For example, you use the quasi-internal instrument tag DIO for starting a pump. Its internal attributes include pump start and stop state (PV), pump start and stop control (DO), controllability condition (OPC), operation lock state (LCK) and so on. In the quasi-internal instrument tag DIO, control conditions that had been incorporated individually have already been implemented, such as prohibiting the pump start and stop control in the state of operation lock.

The advantages of introducing the quasi-internal instrument tags are as follows:

(a) The number of tags has been reduced to less than half which makes management easier.

(b) Control conditions have already been incorporated into the quasi-internal instrument tags,

Table 3 Details of the cooperation with integrated EMS

Type of cooperation		Overview
Energy data cooperation		○ The integrated EMS is notified of aggregated energy data in CSV format. ○ The data aggregation cycle can be selected for each tag from 1, 5, 30 or 60 minutes.
Monitoring and control cooperation	Monitoring	○ The integrated EMS is notified of the conditions of the equipment managed by MICREX-VieW PARTNER in real time. ○ The cooperation cycle is one second for DI and 3 seconds for AI.
	Control	○ The equipment is controlled based on the control order from the integrated EMS and the result is returned to the integrated EMS. ○ The control record is also recorded in the integrated history of MICREX-VieW PARTNER.

Table 4 6 types of quasi-internal instrument tags

Instrument name	Instrument graphic	Function of the quasi-internal instrument tag
AIO (Analog I/O)		Analog input, analog output, industry value conversion, high/low input cut, upper/lower limit monitoring, disconnection monitoring, plate hanging, suspension, replacement and control lock
SUMM (DIO with operation monitoring)		Digital input, digital output, operation monitoring (operating time, number of operations), plate hanging, suspension, correction, preset and control lock
POWF (power factor)		Analog input, power factor conversion, upper limit monitoring, disconnection monitoring, plate hanging, suspension, replacement and control lock
SUMD (digital accumulation)		Counter value input, digital accumulation, input scaling, accumulation upper limit monitoring, suspension, reset, correction, preset and control lock
DIO (digital I/O)		Digital input, digital output, plate hanging, suspension and control lock
DIOTM (DIO with time measurement function)		Digital input, digital output, plate hanging, suspension, continuous operating time and control lock

which eliminates the work of preparing them.

(c) Since an instrument graphic has already been provided for each quasi-internal instrument tag, it is unnecessary to prepare it.

Incorporating the quasi-internal instrument tags within the server eliminates the need to have specific function blocks in the controller and allows engineering independent of the controller models. Furthermore, the controller is less affected by the addition or change of equipment so that expansion or modification can be made easier.

(4) Implementation of Schedule control function and demand monitoring function

MICREX-VieW PARTNER has implemented a schedule control function and demand monitoring function required for its application to public facilities as standard.

(a) Schedule control function

The schedule control function is used to control DO and AO according to a schedule composed of a combination of 3 seasons (summer, winter and other), a setting by the days of the week (see Fig. 3) and a setting on the calendar (see Fig. 4).

Two control methods are used: Fixed-time event method and range event method. The fixed-time event method provides only one control output (ON, OFF or analog setting value) on the preset time and does not check the operation for it. The range event method allows detailed scheduling of control outputs within a control period specified with start and stop. The operation after a control is ordered is checked and if the specified state is not achieved within the specified period, the control order is output again. Furthermore, you can define multiple control suppression conditions required for the operation in accordance with the schedule such as the date and time of a planned blackout or room temperature setting. This makes it possible to recover operations considering the operation pattern and control sequence in the operating time slot; for example, during recovery from a blackout, setting the temperatures of air-conditioners after starting them depending on the facility. This results in efficient operation control which leads to further energy saving.

(b) Demand monitoring function

An example of the demand monitoring screen is shown in Fig. 5. The demand monitoring function is used to predict the usage of electric power or gas in the demand monitoring cycle (15, 30 or 60 minutes) and issue an 8-level alarm before the demand exceeds a preset demand monitoring value. Under the assumption of potential needs for detailed demand monitoring values due to electricity liberalization and diversified electricity contracts, MICREX-VieW PARTNER allows settings to be made by time slot to support a summer charge or time-slot-based charge. A preliminary line detection method has been adopted for demand alarm detection.

The demand monitoring value, alarm occurrence state and predicted demand values can be written to the controller anytime, and it is also possible to adjust the load from the controller.

(5) Simple language

There is a need to be able to easily change the color of the symbols and actually measured values shown on the plant screen based on various conditions or when more than one condition occurs simultaneously. There is another need for carrying out certain control when a specific condition is satisfied according to the state at that time. We have developed simple language to satisfy such complicated field needs that is unconventional. Figure 6 shows an example of description using the simple language for interlocking control logic.

This simple language includes an IF statement,

Fig.3 Example of master schedule screen

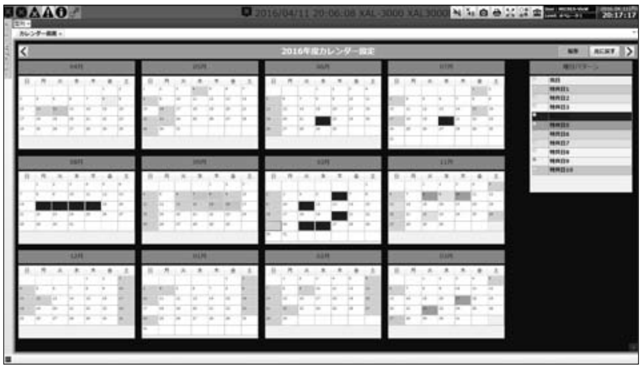

Fig.4 Example of calendar screen

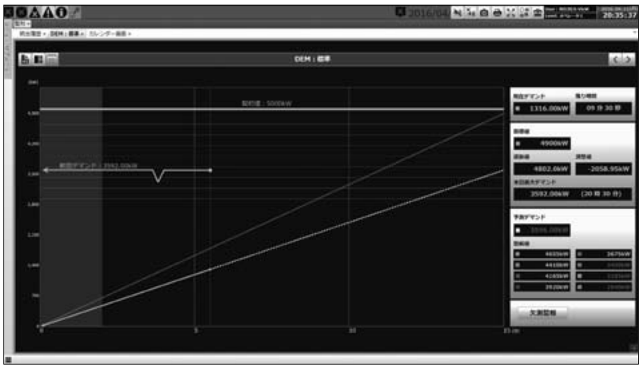

Fig.5 Example of demand monitoring screen

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//
// 連動制御の例
//

//発生条件のチェック
If( #/TAG_001.PV.Value = 1 And #/TAG_002.PV.Value = 1)Then

    //制御出力 ( ON出力 )
    #/TAG_999.PV.Control( 1 )

EndIf

Return 0
```

Fig.6 Example of description using simple language for interlocking control

DO statement, WHILE statement, array and various functions (character string operation, time, arithmetic functions). It allows engineers who create plant screens to build judgment logics to satisfy field needs as desired. One of the major features that should be noted is the ability to write a name of a tag directly to read the value of the tag or provide control output. This makes it easy to create controller logics.

5. Postscript

This paper described the equipment monitoring system "MICREX-VieW PARTNER" that can be applied commonly to the monitoring of various types of equipment and that allows quick and comprehensive engineering from a higher-level EMS to implement cooperation easily.

From now on, we will aim to enhance the convenience of users and the scalability of customization including a further improvement of usability. We will also implement an Advanced application programming interface (API) that can flexibly respond to customer needs and handle a cooperation with existing systems. This will allow the "MICREX-VieW PARTNER" to optimally operate customers' equipment as an equipment monitoring system that cooperates with EMSs capable of further growth.

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