Global Monitoring and Control System That Improves Plant System Engineering Efficiency

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ABSTRACT

In recent years, the engineering function of plant monitoring and control systems have been required to support the entire plant lifecycle. To meet the requirement, Fuji Electric has developed the "MICREX-VieW FOCUS Evolution" global monitoring and control system to improve the efficiency of plant system engineering. The MICREX-VieW FOCUS Evolution enables users to build flexible monitoring and control systems tailored to the scale and application they require by offering both easy customization and high versatility, as well as supporting OPC UA, which is used as a standard multi-vendor communication protocol.

1. Introduction

In 2014, Fuji Electric released the "MICREX-VieW XX (double X)" monitoring and control system for small- and medium-scale industrial plants. Since then, we have been contributing to the stable operation of industrial plants in fields such as steel, chemicals, food, waste treatment.[1] In recent years, plant monitoring and control systems have also been increasingly introduced outside of Japan. However, since the turnover rate for engineers is high overseas, there is demand for computer software-based engineering tools that are easier to learn. Monitoring and maintenance from remote locations and compliance with international standards are essential when delivering plant systems to markets outside of Japan.

To meet these requirements, Fuji Electric developed an integrated engineering system for local engineers both in Japan and abroad. This paper describes the "MICREX-VieW FOCUS Evolution" global monitoring and control system.

2. Challenges in Monitoring and Control Systems

2.1 Overview

Figure 1 shows an example of a MICREX-VieW XX system configuration. At the engineering station, engineering work is performed on the operator stations that serve as the human machine interface (HMI) and the controls stations[2]. At the operator station, personnel use the control station, remote I/O and field devices to monitor and operate the plant to collect the data necessary for plant operation and perform control. Through these operations, the system provides highly reliable and optimal solutions, thereby contributing to energy saving and the stable and safe operation of the plant.

2.2 Challenges

(1) Enhancement of user support functions

With the advancement of digital technology, the engineering work for recent plant monitoring and control systems has evolved and are now starting to support the entire lifecycle of the operator station and the control station, from engineering to service. Outside of Japan, there is a need to consolidate the engineering environments of entire plant systems to improve engineering efficiency. As such, companies require engineering environments that allow for the effective use of developed application assets regardless of the scale of the plant system.

Since the engineer turnover rate is high outside of Japan, engineering tools that are easy to learn are required. In addition, to meet the need for support for remote work and collaborative work among engineers in different locations, it is necessary to provide environments in which engineering operations can be easily performed by anyone from anywhere.

(2) Enhancement of the HMI function

When carrying out development work in Japan in response to changes in specifications for plant monitoring and control systems abroad, the process of translating specification changes into Japanese and the time losses due to time difference during verification of specifications. To allow engineers outside of Japan to quickly carry out tasks from application development to testing on site, it is necessary to provide a simple and efficient engineering environment. The HMI environment needs accommodating rules that are specific to local engineers, as well as customization and pack-

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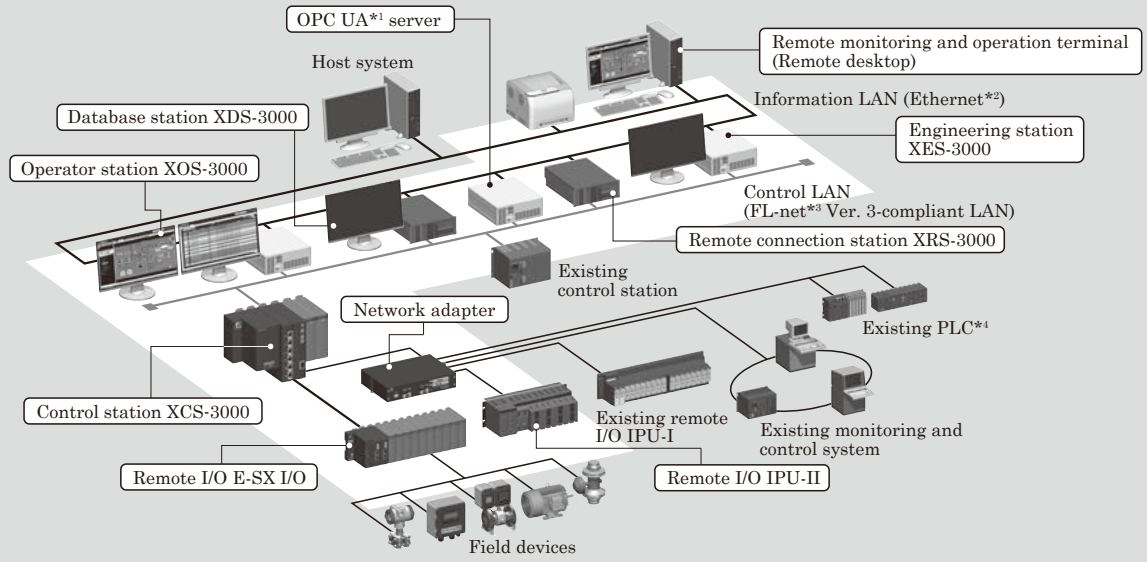

*1 OPC UA is a trademark or registered trademark of the OPC Foundation.
*2 Ethernet is a trademark or registered trademark of FUJIFILM Business Innovation Corp.
*3 FL-net is a trademark or registered trademark of the Japan Electrical Manufacturers' Association.
*4 PLC: Programmable logic controller

Fig.1 Example of a "MICREX-VieW XX" system configuration

aging based on user requirements.

(3) Improving versatility

Systems that employed the MICREX-VieW XX required dedicated equipment. For example, when equipment failed in plants abroad, recovery took time because replacements needed to be sent from Japan. To achieve systems that facilitate procurement, implementation, and engineering even abroad, such constraints need to be eliminated.

(4) Enhancement of monitoring and maintenance functions

For Japanese plant manufacturers operating outside of Japan, prerequisites for adopting a plant system include the ability to perform maintenance in a timely manner and in short lead times similar to operations in Japan. Accordingly, we need to provide an environment that allows remote monitoring and maintenance without the need to visit the worksite.

3. Characteristics of the "MICREX-VieW FOCUS Evolution" Global Monitoring and Control System

3.1 Outline

Figure 2 shows an example of a system configuration for the MICREX-VieW FOCUS Evolution. Designed to be applied in plants abroad, the MICREX-VieW FOCUS Evolution enables users to develop applications with the integrated engineering tool, and build flexible systems tailored to the scale and application. It also supports the remote operation of multiple sites using smart devices. This is a monitoring and control system that ensures both customization and versatility at a high level.

3.2 Integrated engineering tool and application package

(1) Automatic synchronization of tool integration and TAG information

For this system, we offer an integrated engineering tool that achieves higher usability by combining multiple engineering tools that were previously separate. Figure 3 shows the configuration of the integrated engineering tool. The following tools can be combined and used flexibly under the integrated environment. Fuji Electric offers packages that can be used with the various applications that run on these tools [see (3) for details].

- ○ Network configuration engineering tool
- ○ Controller engineering tool
- ○ HMI screen engineering tool
- ○ Simulation
- ○ Standard template and standard library

The integrated engineering tool centrally manages not only the various tools and applications described above, but also the TAG information used to identify the devices and equipment that are subject to monitoring and control. Since the tool automatically synchronizes all applications, every time a user edits an application or operates the control station, the information of related tools and applications is also automatically updated. Therefore, users are relieved from the hassle of managing applications for each tool as was required in the past. In addition, users do not need to reconnect TAG information, which was previously retained separately for the controller and the HMI screen, every time the information is updated. These functions significantly lighten engineering workload and improve efficiency.

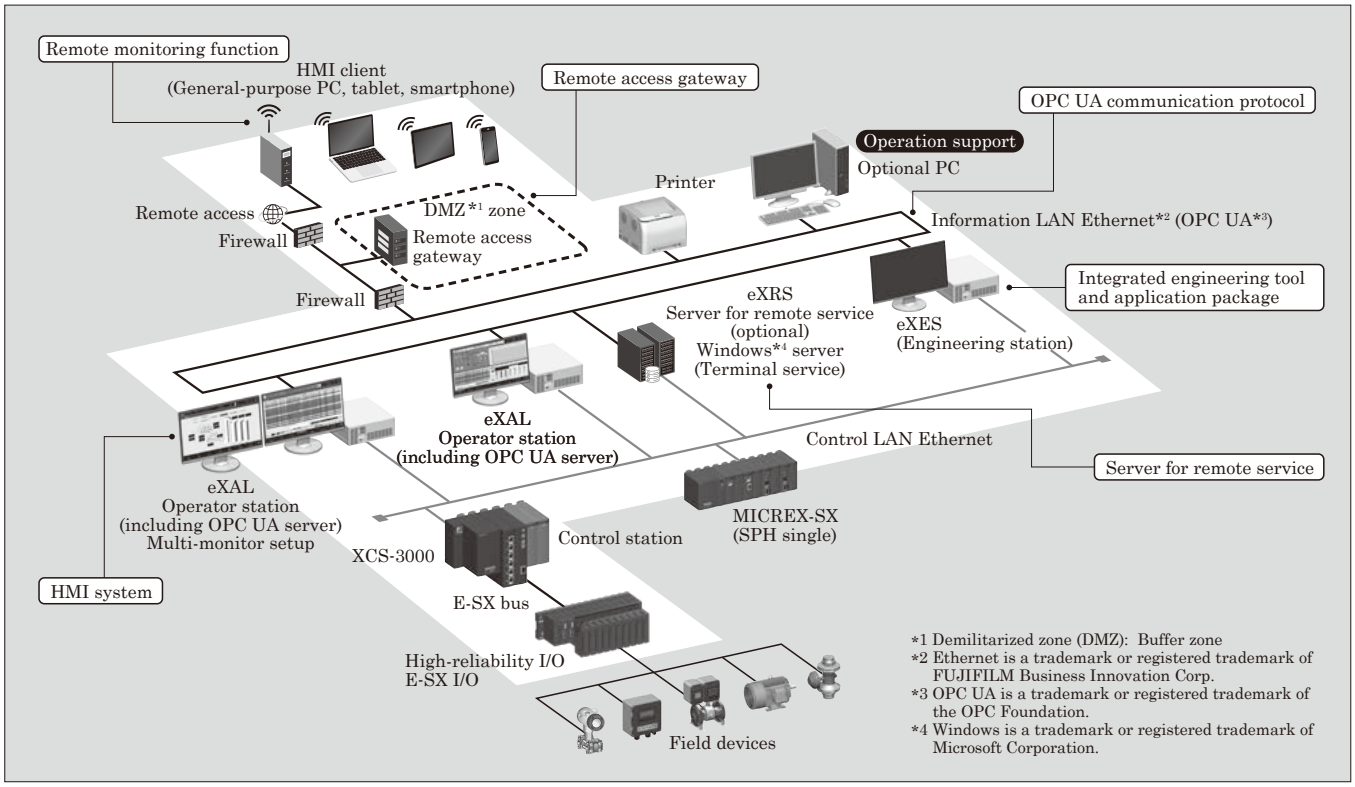

Fig.2 Example of a "MICREX-VieW FOCUS Evolution" system configuration

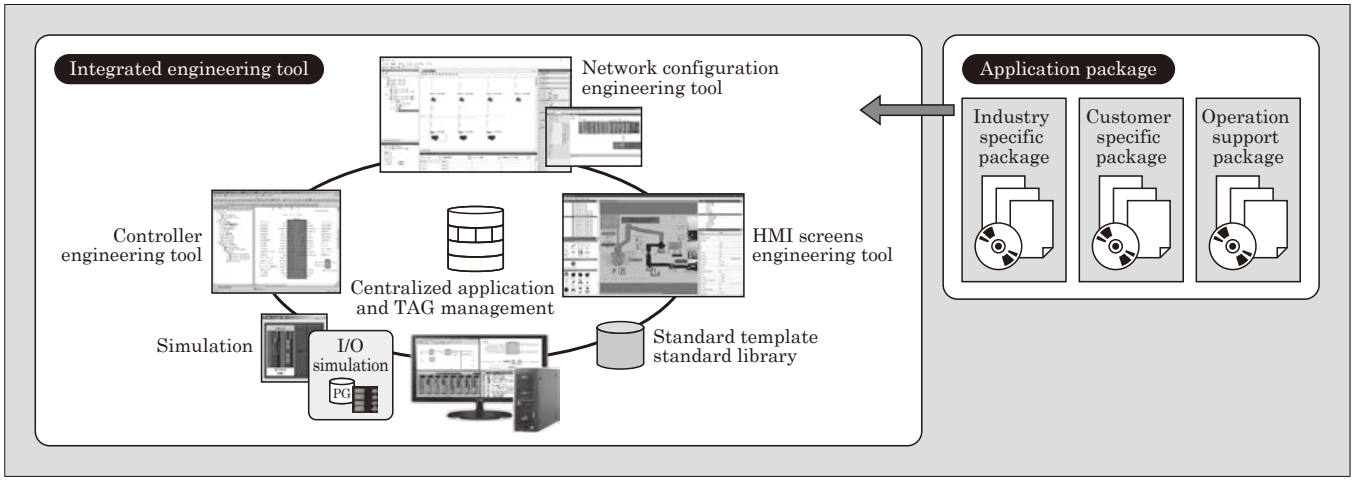

Fig.3 Configuration of the integrated engineering tool

(2) Multi-user function

Engineers in Japan and abroad are increasingly collaborating in the development of plant monitoring and control systems for countries outside of Japan. In such cases, there are concerns that development efficiency may decline due to mistakes in the management of the application development process, and that labor hours may increase due to complex management. To prevent these issues, we developed the multi-user function. Since application files under development are centrally and exclusively managed on the dedicated server, multiple engineers cannot modify the same application at the same time.

Furthermore, users can reuse developed applications at new worksites. Reusing proven and reliable applications is effective for improving development efficiency.

(3) Sophisticated utilization of application packages

Fuji Electric offers application packages to help users develop applications. A wide range of packages are available for various industries and for operational support, allowing engineers to select a suitable package for the plant control system to be developed. To improve the efficiency of application development, users have not only used these packages, but have also created templates of programs and screen data that

have a proven track record and managed them for the purpose of reuse with their own management rules. However, since local engineers could not modify the individual specifications of these application packages and templates for reuse, they needed to ask the developers of the template or package to develop the modified version.

To solve this issue, we developed the object sharing system illustrated in Fig. 4. The system works as follows: When a user registers developed program parts and screen parts in the package library for the purpose of reuse, the user defines information known as structured TAG data to link the definition information of the program variables and screen parts to be reused to the elements of the structured TAG data. This system allows local engineers to modify the individual specifications of applications, which could previously only be done by the developers. By simply arranging program parts during program development, the corresponding screen parts can be automatically created.

Utilizing these functions will drastically improve development efficiency at worksites outside of Japan and allow development to be completed locally.

3.3 HMI system

(1) Screen customization by the user

The HMI screen is an important user interface on which plant operators constantly perform monitoring and operation. Thus, its usability affects customer satisfaction significantly. Screens must meet the specific requirements for various fields and end users. In particular, the ability to perform flexible customization is important for local engineers to satisfy such requirements.

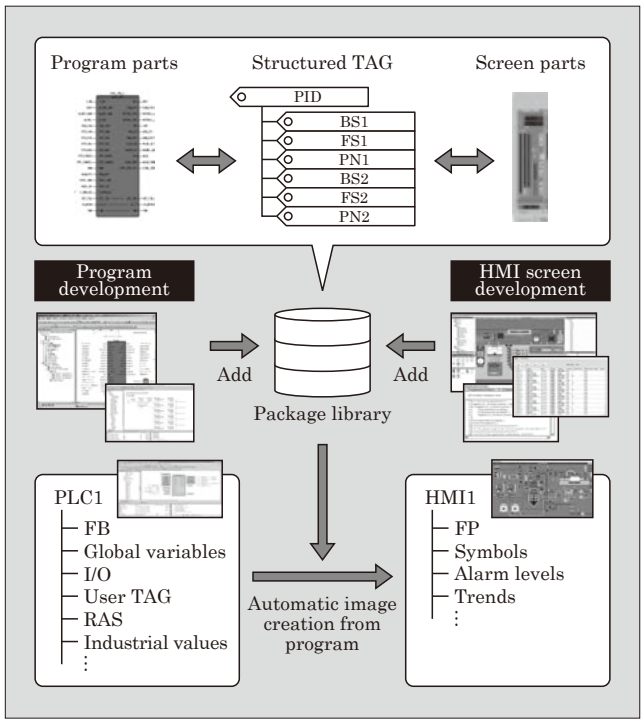

Fig.4 Object sharing system

We developed a new function to customize screens with a general-purpose scripting capability that enables the execution of simple programming languages. Figure 5 shows the internal structure of the HMI system of the MICREX-VieW FOCUS Evolution. Since the HMI platform used to be equipped with screens and parts in advance, users could only modify the combination of parts. By separating them from the HMI platform, we have made it possible to perform customization and packaging of screens and screen parts on the HMI system of the MICREX-VieW FOCUS Evolution. By using the general-purpose ECMAScript*1 for customization, users can add plant-specific motions to the HMI screen. ECMAScript supports 258 script functions for 21 categories to enable flexible customization.

(2) Multi-window function

Figure 6 shows an example of the multi-window display (tile display). The HMI system of the MICREX-VieW FOCUS Evolution has a multi-window display function that displays a maximum of eight

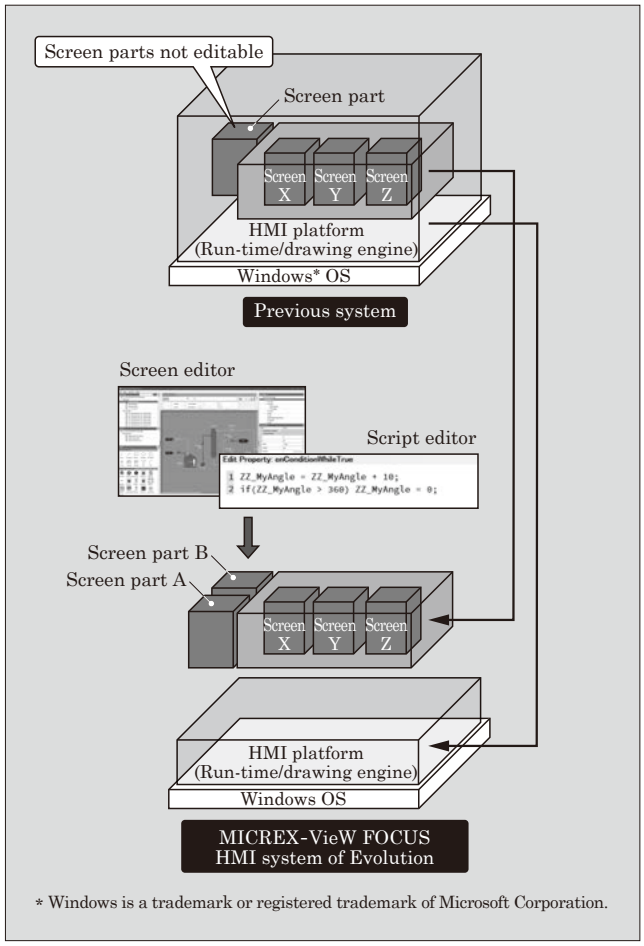

Fig.5 Internal structure of the HMI system of the "MICREX-VieW FOCUS Evolution"

*1 ECMAScript is a trademark or registered trademark of Ecma International.

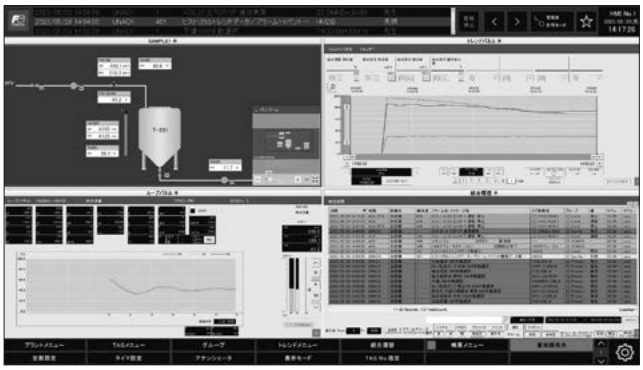

Fig.6 Example of the multi-window display (tile display)

monitoring screens at the same time. Users can select from the following three display types.

- ○ Tab display
- ○ Floating display
- ○ Tile display

(3) Increase in PC choices

We adopted our own proprietary database to eliminate the use of Microsoft SQL Server*2, which was necessary in the previous system. This measure relaxed the requirements to use the system on computers, enabling general-purpose PCs to be used.

3.4 Remote monitoring system

(1) Remote monitoring function

The MICREX-VieW FOCUS Evolution can be used to remotely monitor local plants by means of HMI clients such as general-purpose PCs, tablets, and smartphones.

This function was implemented using a remote service server (HMI server) on the control LAN as shown in Fig. 2. The information LAN has a demilitarized zone (DMZ: buffer zone) with firewalls to accommodate the remote access gateway. As a result of this feature, users can connect HMI clients to the remote service server via the Internet to monitor and operate the plant from the browser. This system allows users to remotely monitor even plants located outside of Japan with ease without constructing a virtual private network (VPN) on the client devices.

(2) Adoption of OPC UA*3 communication protocol

For the monitoring and control systems of industrial plants, it is important to have multi-vendor communication technologies, which enable connections to the systems, devices and even cloud systems of other vendors. Currently, many technologies are available for multi-vendor communication, and they can be selected according to the purpose. Among those, OPC UA is gaining attention as a promising option.

OPC UA is growing as a communication technology for control systems. It has become an international standard as a protocol recommended in IEC 62541, which is a communication-layer (communication function) standard of the Reference Architecture Model Industrie 4.0 (RAMI4.0), which in turn is a reference architecture model of Industrie 4.0, promoted mainly by Germany. China and Singapore have adopted OPC UA as national standards, and it is expected to spread to other regions outside of Europe.

For the MICREX-VieW FOCUS Evolution, we provided the operator station with an OPC UA server function to smoothly synchronize the system to various systems both in Japan and abroad. The OPC UA synchronization data automatically synchronizes with the TAG information defined using the integrated engineering tool.

As a result, for the various processes that make up the engineering process, from the software design process to testing, the number of labor hours can be reduced to half of that of the previous system, as shown in Fig. 7. This will also allow customization to be performed locally when plants are to be expanded in scale.

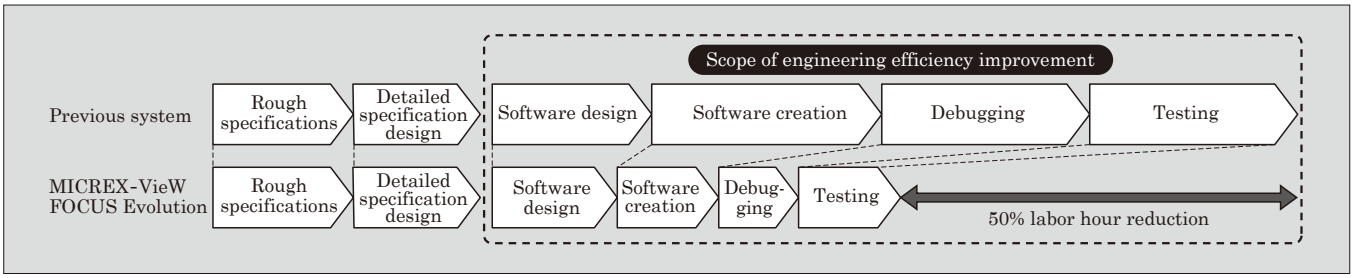

Fig.7 Reduction of engineering labor-hours

*2 SQL Server is a trademark or registered trademark of Microsoft Corporation.

*3 OPC UA is a trademark or registered trademark of the OPC Foundation.

4. Postscript

In this paper, we have described a global monitoring and control system that improves the efficiency of plant system engineering. This system allows users to build flexible systems tailored to the scale and application and can be operated globally. It also supports the stable operation of plants through remote monitoring using smart devices. This monitoring and control system ensures both easy customization and high versatility and is constantly evolving.

Fuji Electric will continue to expand the functions of the monitoring and control system to improve the engineering environments of our customers.

References

(1) Sato, Y. et al. Latest Operation and Engineering Functions of Small- and Medium-Scale Monitoring and Control System, "MICREX-VieW XX". FUJI ELECTRIC REVIEW. 2014, vol.60, no.1, p.38-42.

(2) Nagatsuka, K. et al. Evolving of Monitoring and Control System "MICREX-VieW XX (Double X)". FUJI ELECTRIC REVIEW. 2016, vol.62, no.3, p.186-192.

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