Upgrading the MICREX-IX Series of EIC Integrated Control Systems

Kisaburo Sasano
Hiroaki Hayakawa
Masato Nakano

1. Introduction

Since being introduced to the marketplace in 1992, the MICREX-IX series of EIC integrated control systems has been delivered in large quantities to relatively large-scale system applications. However, due to the economic recession and the wide-spread installation of large-scale plants, demand for construction has shifted to medium-scale plants and overseas plants. The demand for price reduction in instrumentation control systems has forced manufacturers to further reduce costs.

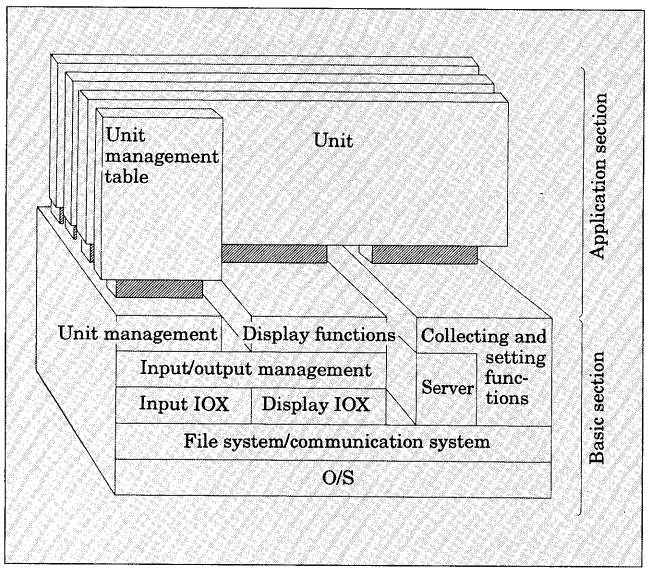
Responding to these present day user trends and requirements, Fuji Electric has been successful with its efforts in medium-scale systems, overseas marketing and product development in corresponding fields of application.

2. Development of Element Technology for Series Enhancement

2.1 Upgrading the MMI Platform

The MMI in MICREX-IX has the software structure shown in Fig. 1, consisting of a basic section called the "MMI platform" and an application section comprised of application-specific software units. The interface between these software units is discrete. When functions are upgraded, the altered section is limited so that a highly reliable system can be configured. The display IOX (Input and output processing for display) in the MMI platform has been made compatible with high resolution display (1,280 × 1,024 pixels).

Fig. 1 Software physical model of integrated MMI system



In medium-scale systems, a database function to manage the process data is stored in the MMI platform so that a stand-alone MMI system can be configured by changing the scale of the application section.

Moreover, in the FAINS system operator station IOS-2500H and IMS-2500H for public utility plants, an operation unit for water and sewage treatment has also been installed.

2.2 High-speed panel display

Previously it was difficult to achieve a high speed display of the trend and document panels, which indicate time-serial data from the past up to the present in the range specified by the user, because much time was required to retrieve the necessary data from the database and to process the display data.

The following improvements have been realized to speed-up this process by 40%.

(1) High-speed access to the database
The frequency of access to the database has been reduced. Effective processing to access and retrieve files has been realized.

(2) Improvement in display processing of the document panel
Processing all the characters and space codes in 180 lines and 64 columns has been changed to displaying only the characters and excluding the space codes.

2.3 Broadcast data link

The data files in each station have been linked through broadcast communication to increase the data display speed of the CRT and to allow instantaneous alarm notification.

To further increase the display speed of plant panel data and I/O alarm information, the data for each sta-

tion has been made variable in length, i.e. 1 to 3 kW, to improve the efficiency of data exchange.

2.4 Network applications

The distributed filing system (Fuji sensor-based integrated NETwork system: FUJINET) has been used with the database station. This system can communicate between the components connected to the Ethernet*1, without being conscious of their compatibility. As a result, it is possible to add or alter plant panel data and to save trend and document data for multiple engineering stations connected to general-purpose LAN.

3. Upgrading Large-scale Systems

The MICREX-IX is configured with the following components.

(1) The IOS-2500 integrated operator station is equipped with easy-to-use windows and powerful computer linkage functions.
(2) The IDS-2500 integrated database station enables easy exchange of the process data with computers and unified management of the alarm information.
(3) The ICS-2500 integrated control station can freely set the relative amounts of electromechanical control (E) and instrumentational control (I). This station operates at high speed.

Table 1 describes the increased range of applications in which the system can be configured with a high degree of freedom.

Table 1 Upgrading the IX system

Item	Conventional IX system	Upgraded IX system
Number of user tags	17,280	32,752
Number of logging sheets	64	128
Number of logging items	1,023	2,046
Simultaneous printing for multiple printers	Not applicable (only one printer)	Applicable (Maximum 8 printers)
IPU input/ output modules	27 kinds	◦ mV input module (For small voltage input) ◦ Potentiometer input module (For receiving valve opening signal)
Internal instrument	12 kinds	◦ Integrator: 3 kinds (DI integration, DI runtime integration, BCD integration) ◦ Batch counter: 2 kinds (Analog integration, pulse integration) ◦ Indicator: 3 kinds (Analog input processing, power factor, wind direction)
Overseas options	Domestic only	◦ English version of IOS-2500, FPROCES ◦ Hungle font of IOS-2500

4. Development of Medium-scale Systems

The requirements for medium-scale system are, on the one hand, low price, compact size, open architecture, high quality and high reliability, and on the other hand, expandability and compatibility with system responses to plant expansion, connection to upper-level systems, or application of existing facilities.

The MICREX-IX 2000 series has standardized its architecture with upper-level system in order to share applications and common hardware. This has resulted in excellent reliability, maintainability and flexibility.

Figure 2 shows the system configuration and Table 2 lists the system specifications. The system features are as follows.

4.1 IOS-2000H operator station

The IOS-2000 has compactly integrated the MMI (Man-Machine Interface) and the database functions of large-scale systems. The external dimensions and operation methods are the same as those of the IOS-2500 to enable consistent operation of medium and large-scale hierachial systems.

Monitoring and operating displays have been optimized for medium and small-scale systems, although the number of data points and panels for monitoring have been reduced. In addition to conventional functions such as open networking and single windows, the IOS-2000 has enhanced its monitoring and operating environment with a user-friendly, high-resolution CRT.

The IOS-2000H has the following features.

(1) Enhanced monitoring and operating environment

The high-resolution CRT (1,280 × 1,024 pixels) displays much more data than before in the panel. The cascaded dynamic windows in the panel can be dragged by pressing one's finger to the screen.

The IOS-2000H has added circle displacement and message display to the data display functions, and has differentiated the sounds generated during a malfunction or when a key is pressed.

(2) Flexible system configuration

For systems mixed into large-scale systems, the IOS-2000H can monitor the system status and adjust the clock.

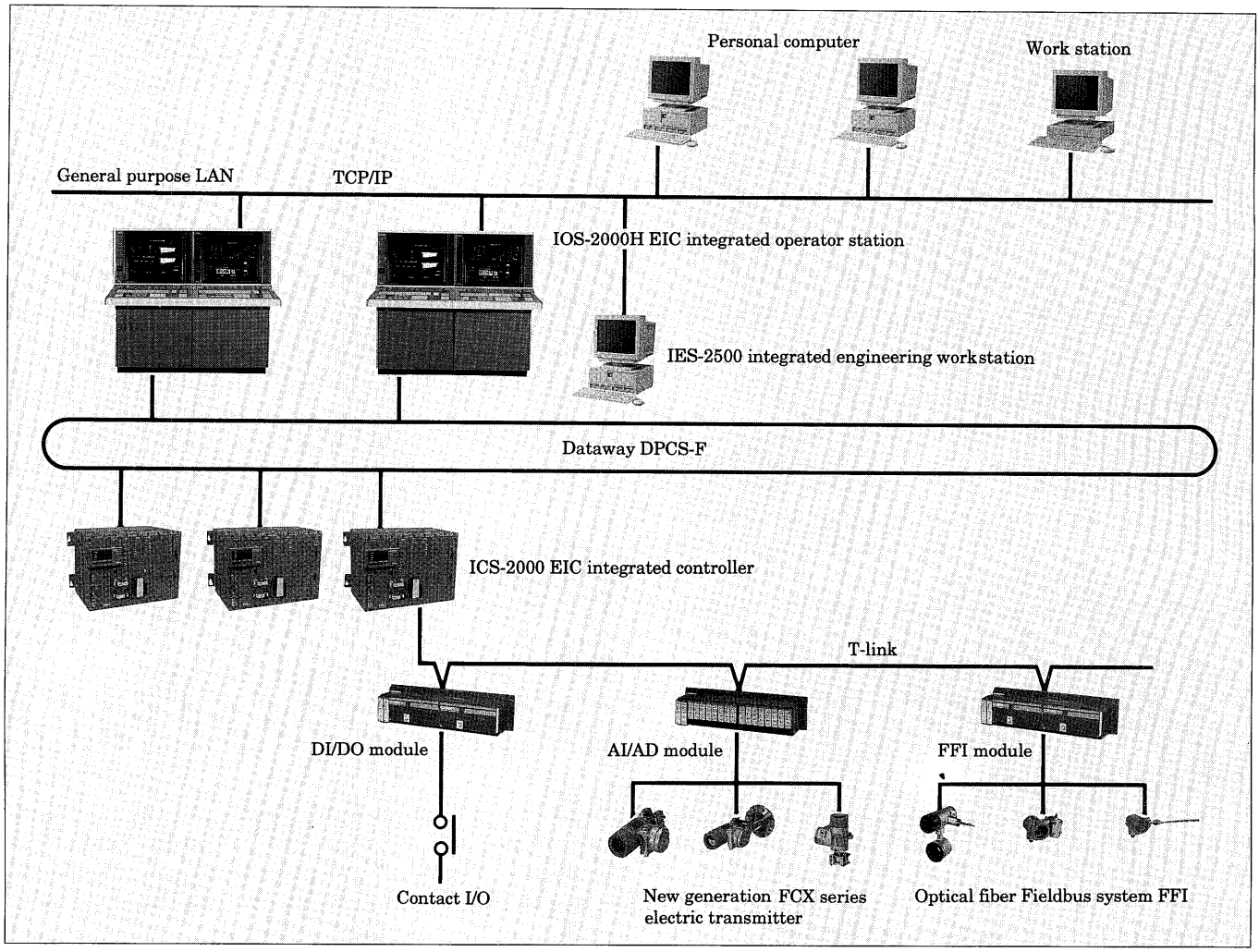
In addition, the IOS-2000H provides an efficient method to monitor two facilities with one CRT, whose monitoring objects are grouped according to the "grouping function for CRTs."

(3) Networking

A package is provided that uses a network with TCP/IP protocol, i.e. the data service function and the computer linkage function, to enable easy connection of personal computers, workstations and industrial computers.

*1 : Ethernet is a registered trademark of XEROX, USA.

Fig. 2 MICREX-IX 2000 series system configuration



4.2 ICS-2000 control station

The molded structure of the modules in the shelf (e.g. the control board, network board and the power supply module) has been improved to withstand the environment. This structure required no dedicated cabinets, and allows installation without cabinets or direct attachment to the operation/instrumentation panel, thereby saving space.

The PIO is either connected via the T-link (Type I) or connected directly (Type II). Type I is applicable for the installation of distributed I/O. In type II, the PIO is connected directly and applicable for high speed electrical control. Both types can be duplicated in structures for unit redundancy.

The ICS-2000 is completely software compatible with the upper-level ICS-2500, and has nearly the same performance. It comes with an EI free scheduler, which adjusts and synchronized the electromechanical (E) and instrumentational (I) controls to determine an optimum control performance.

The ICS-2000 has the following features.

(1) Board module structure

The control board is installed in a molded casing to improve its environmental resistance. This board module structure allows easy and safe maintenance and module replacement.

(2) High reliability

Controller unit redundancy and duplication of the dataways, e.g. the T-link and the P/PE-link, makes the system highly reliable. Moreover, application software can be compiled without being conscious of the single or duplex configuration.

(3) Maintenance display

The maintenance board is equipped with a standard LED front panel that displays error information and operation guidance. Displaying the location of a fault on the front panel makes restoration and maintenance work easy.

Collecting RAS data, starting the system and changing the display to the English version can be performed by control buttons. Depending on the application, it is possible to output the status and alarm signals to the external DO through contacts, and to maintain the control station from a remote location through connecting a modem.

4.3 IES-2500 engineering station

The software development tools FPROCES-C (for

Table 2 MICREX-IX 2000 series system specifications

System	Number of operator station that can be connected	3 stations (IOS-2000H)
	Number of control station that can be connected	30 stations (ICS-2000/2500)
	Number of tags	17,280 (including 8,640 modules)
	Status/contacts	30,720
	Trend data	1,024
IOS-2000H	Main memory	32 MB
	CRT size, display resolution	21 inches, 1,280×1,024 pixels
	Number of CRTs	2 units/one station
	Display color	32 colors (equipped with flicker function) (Multi-color display by mixing)
	Touch screen	Infra-red ray system
	Plant panel	128 pages
	Group panel	8 tags×1,080 pages
	Trend panel	8 pens×128 pages (High speed: 8 pens×128 pages)
	Data way	DPCS-F, TCP/IP: 1 line each
	Optional devices	Color hard copy (1 unit/CRT), Printer (3 units), voice alarm
	External dimensions (mm)	630 (width)×1,150 (height) ×1,300 (length)
ICS-2000	Memory capacity	256k words for program, 128 words for data
	Number of input and output (per controller)	Digital: 8,192 max. (all digital) Analog: 2,048 max. (all analog)
	Program language	Ladder, FB-chart, SFC, conditions table, loop-chart, time chart
	Program execution time	Sequence calculation: 0.125 μs/contact, 0.125 μs/coil Fixed point calculation: 0.33 to 6.67 μs Floating point calculation: 4.99 to 9.50 μs Loop control calculation: 200ms/cycle
	Dataway	DPCS-F: Max. 2 lines (1 line/board) P/PE-link: Max. 2 lines (1 line/board) T-link: Max. 4 lines (2 lines/board)
	External dimensions (mm)	Type I: 410 (width)×266 (height)×260 (length) Type II: 570 (width)×266 (height)×260 (length)

the controller) and FRPOCES-M (for the MMI), which support the design, manufacture, test and maintenance of the control system software, have improved the productivity and quality of the control system software. These tools, based on MS-Windows*2 are integrated software that is independent of the system scale.

Major functions are described below.

(1) Multilingual applications

A specification description language can be used that corresponds to each application and covers the loop diagram, time chart table, ladder diagram, FB (Function Block) diagram, SFC (Sequential Function Chart), etc. It may also be used in combinations.

*2 : MS-Windows is a registerd trademark of Microsoft, USA.

(2) Integrated management of tags and labels

It is possible to integrate the management of label for electromechnical control and tag number for instrumentational control and the computer control of data.

(3) Unified management of the tag name

The labels and tag numbers can be used without being conscious of their address, data format and data related equipment.

5. Development of Public Utility Systems

5.1 FAINS system

The FAINS (Fuji Aqua Information System) is an integrated management system for water and sewage treatment that was developed to handle plant operation/management systems such as water treatment plants, sewage treatment plant, etc. The new FAINS-IX has enhanced the concept and resources of the previous FAINS-1000.

This management system consists of the IOS-2500H operator station, the IDS-2500H database station, the ICS-2500 control station, and a computer, which are connected with each other through the control LAN (DPCS-F). (Fig. 3)

The application software of the controller and the MMI can be designed using the IES-2500 engineering station, which is shared with the MICREX-IX.

The software design tool FPROCES-M identifies the different specification requirements for instrumentation fields and the public utility fields, and responds accordingly to each field. The IOS-2500H and IDS-2500H are MMIs that cover the monitoring of medium to large-scaled objects.

Many local governments cannot afford large expenditures of funds or man-power (engineers) and therefore require systems that are compact, have easy maintenance and are economical. Fuji has also developed the IMS-2500H as a small and medium-scale MMI, in which the IOS-2500H and IDS-2500H are integrated into one compact unit.

5.2 IOS-2500H and IDS-2500H

The IOS-2500H stores the CRT monitor, keyboard, video-display control board, memory board, etc. in its console desk. A maximum of three CRTs and keyboards can be mounted on a single operator station.

One IDS-2500H may be connected to the DPCS-F to collect, record and manage the plant data.

The IOS-2500H and IDS-2500H have the following features.

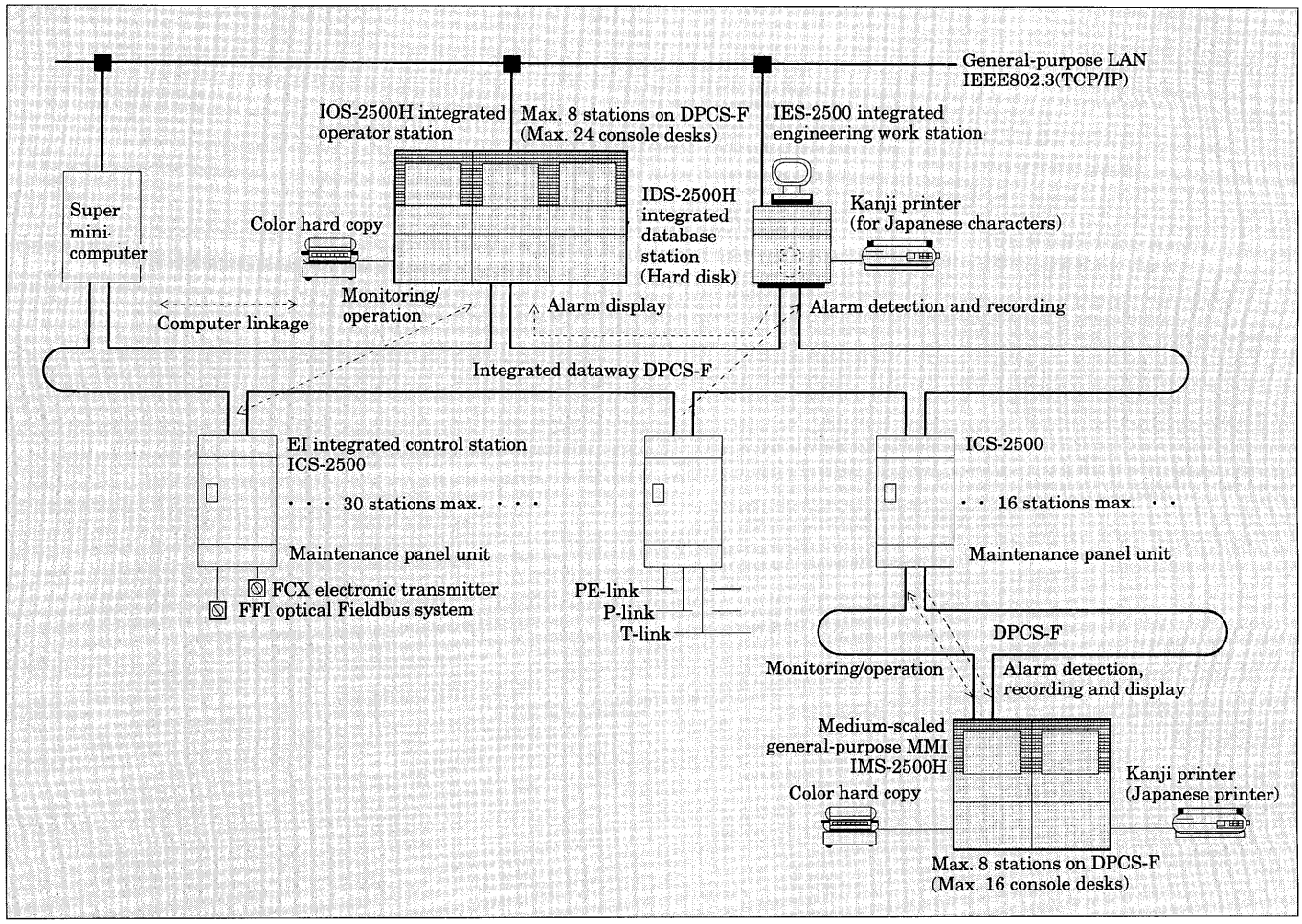
(1) A high resolution CRT (1,280 × 1,024 pixels)

(2) The data read and write function of the process value panel use the process data name instead of the tag number.

(3) Enhanced operating performance

Operation is simplified by new windows and by full screen setting of the process data.

Fig. 3 FAINS-IX system configuration



5.3 IMS-2500H

The IMS-2500H, a medium-scale general-purpose MMI, stores the CRT monitor, keyboard, video-display control board, memory board and the hard disk (dedicated to save the plant data) in the console desk. The IMS-2500H is about 1/2 to 2/3 of the IOS-2500H or IDS 2500H in scale and capacity.

The IMS-2500H can be used as an MMI for local monitoring large-scale system when combined with the IOS-2500H and IDS-2500H.

The advantages in this case are as follows.

(1) Since the IMS-2500H has the same architecture as the IOS-2500H and IDS-2500H, CRT resolution is the same, and monitoring and operating functions, e.g. to be operate devices and set data, can be shared with the IOS-2500H.

(2) IMS-2500H plant panel display and document format applications are compatible with those of the IOS-2500H, allowing common use or transfer.

5.4 ICS-2500

The controller of the FAINS-IX, ICS-2500, is common to the MICREX-IX control station.

Fuji has developed a new maintenance panel unit to enhance maintenance functions in use with the controllers. This panel unit has such functions as the detection of controller abnormalities, LED error display, a storing function that saves the abnormalities on IC cards, and a function to display the information in the IC cards on the panel of the IES-2500, after the abnormalities have occurred.

6. Conclusion

The MICREX-IX is used not only in the field of instrumentation, but also in public utilities and the electromechanical industry. In this paper, recent trends and results of the MICREX-IX have been presented concerning developments in medium-scale and other systems specific to public utilities.

The recent trends of instrumentation and control systems, towards open architectures that use man-machine components such as work stations, and small-scaled systems that use personal computers, are spreading in various applications.

Fuji Electric is responding to the above trends by developing new products that effectively utilize general-market devices and systems, enhance existing system technology, and improve service to the users.

In this regard, the authors wish to thank the users in advance for their future guidance.