"MIDDLESTAR" Middleware
for Process Control Computer System†

1. Introduction

The advances in equipment automation in recent years have aimed for reduced manufacturing costs, improved quality, and labor savings. At JFE Steel, replacement and renewal of the obsolete process control computer systems in steelworks are carried out according to the midterm plan. To meet the requirements for inexpensive replacement and renewal of process control computer systems, JFE Electrical & Control Systems has developed "MIDDLESTAR*." This is a middleware software package designed to facilitate system development on commercially available standard personal computer (PC) servers for universal use with functionality and performance to meet the needs for high-level process control. MIDDLESTAR has been released since 2005. An outline of the product follows.

2. Features of MIDDLESTAR

Process control computer systems for the iron and steel industry must meet the following requirements for functionality and performance:
(1) High response for real-time control
(2) Sufficient reliability to ensure continuous operation without ever stopping (24 hours a day, 365 days a year)
(3) Diverse communication functions to permit system linkages in a heterogeneous environment
(4) A human-machine interface with good operability and response

Figure 1 shows an example of the configuration of a process control computer system.

The middleware for the control system, a type of software with functions necessary for meeting these severe requirements, is located between the basic software (what we hereafter refer to as the operating system, or "OS") and application program.

MIDDLESTAR integrates various types of communication software, development-support functions, ana-
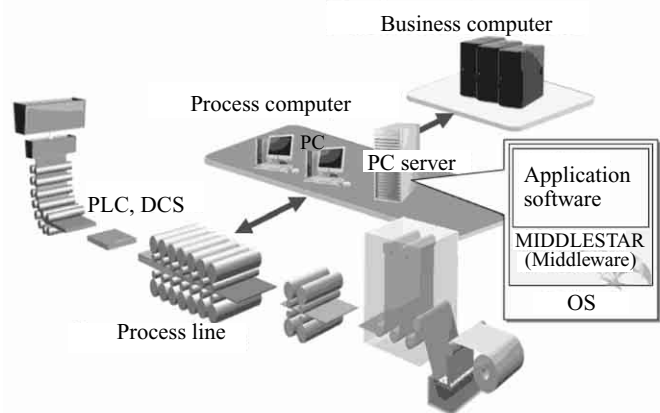

Fig. 1　Process control system configuration

lytical functions for troubleshooting, and so on, in addition to functional groups of specifications for general-purpose application.

Figure 2 shows the functions of MIDDLESTAR.

The features of MIDDLESTAR are described below.
(1) Process Control Computer Systems on PC Servers
MIDDLESTAR is middleware software compatible with an open OS operating on a commercially available PC server. The product can be used to build a highly reliable, small-to large-scale process control system by adopting peripheral devices that meet system requirements. At JFE Steel, the application of MIDDLESTAR has realized replacement and renewal of proper computer systems established by heavy electric industry to general-use PC servers.
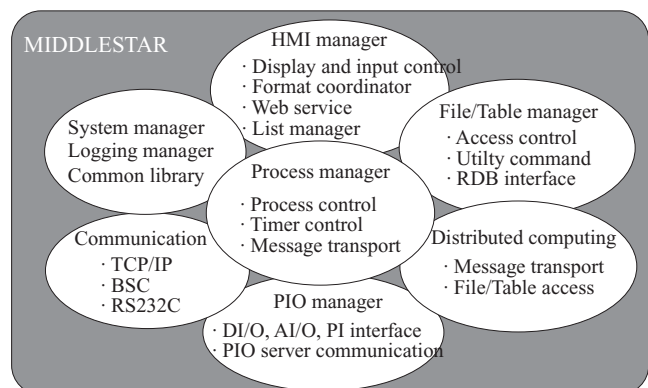

Fig. 2　MIDDLESTAR functions

(2) Distributed Computing Environments

Application of the MIDDLESTAR provides a distributed computing environment such as multiple computers connected and operated in parallel to realize a large-scale system just by using personal computers for universal use. MIDDLESTAR supports the process communication among multiple computers in the network and discretely accesses files from the computers arranged in distributed computing environment without the recognition of computers (**Fig. 3**).

(3) High-response Process Input/Output

Process input/output to and from control equipment can be transmitted at 100 ms intervals, at maximum speed. This enables the application of MIDDLESTAR to rolling mill systems that require high response.

(4) Two Types of Program Driven Methods

MIDDLESTAR supports two kinds of program driven methods : an event-driven method with priority on high response and a message-driven method. These methods can be used in combination, to obtain the suitable software design to meet system requirements.

(5) Versatile Communication Functions

MIDDLESTAR communicates with business computers, sequencers, measuring instruments and even barcode readers and PDA terminals.

(6) Real-time Screen Display Functions
for Web Browsers

Besides its human-machine interface for general client/server use, MIDDLESTAR has real-time functions for the automatic updating of events and periodical display information, event-driven notifications and alarm information for Web browsers, and graphic display. The use of Web browsers improves maintainability by eliminating the installation of software on the CRT terminal side.

3. Scope of Application

MIDDLESTAR is applied to all areas of process control computer systems for the iron and steel industry owing to the high-speed response of input/output signals to and from control equipments and enhanced distributed computing functions.

Besides the application for the iron and steel industry, MIDDLESTAR is applied to production management systems for manufacturing industries, logistical systems such as automated warehousing and inventory control systems, sensor systems for data collection, and systems composed of multiple servers for communication with other systems.

4. Benefits of Introduction

The application of MIDDLESTAR has the following benefits:

(1) MIDDLESTAR is configured with a universal API (application program interface) to facilitate the sharing of application programs to several computers.

(2) MIDDLESTAR handles OS instruction operations, communication procedures, and other functions that require expert knowledge. Therefore, software developer who has least expert knowledge can perform efficient and high-quality software development. MIDDLESTAR also improves reliability for system maintenance and troubleshooting.

(3) MIDDLESTAR quickly absorbs and adapts to changes with hardware and OS upgrades. This simplifies the replacement and renewal of computer system by shortening renewal period and facilitating the transfer of developed system resources.

5. Conclusions

In 1999, KDK Elesys and Kawatetsu Systems began developing middleware software packages based on their own concepts and applying them to process control computer systems for the iron and steel industry and other application fields. Then, process control computer businesses of these companies were consolidated by JFE Electrical & Control Systems. The middleware development technologies garnered by these two companies were used to integrate two classes of middleware and develop the new MIDDLESTAR system with improved functionality and performance.

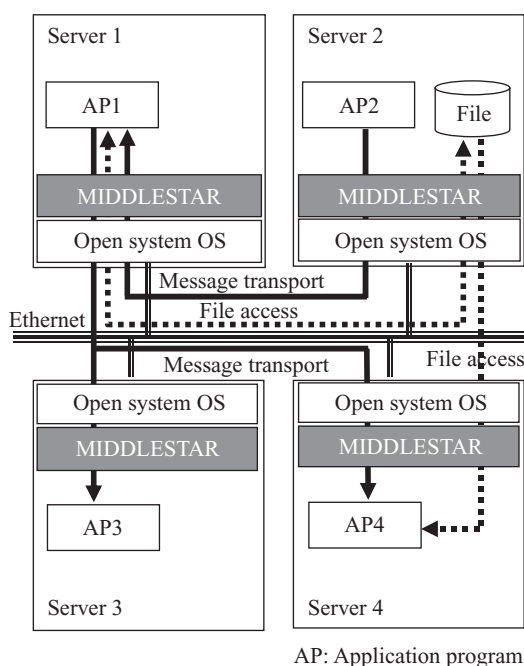JFE Electrical & Control Systems is engaged in a

AP: Application program

Fig. 3   Distributed computing concept

project to replace and renew obsolete process control computers for JFE Steel and to develop production management systems for manufacturing industries. The current targets for the company are to construct total computer systems based on recent proposals incorporating hardware components and MIDDLESTAR at the core.

The company will be continually enhancing the functions and performance of MIDDLESTAR by introducing the latest hardware and software technologies and aggressively pushing forward in the market as a major product of process control middleware.

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