Transformation of Edge Computer in OT field

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Abstract: To achieve smart manufacturing, it is essential to implement digital transformation that involves transmitting and utilizing the vast amount of information generated on-site to the cloud. Directly sending data collected from sensors to the cloud via the internet can lead to increased network load and high latency issues due to the sheer volume of data. Additionally, transmitting raw data without processing poses significant security risks. Therefore, edge computing technology, which allows on-site computers to rapidly process large volumes of data, perform data processing and analysis locally, and send only the minimal necessary analysis results to the cloud system, is gaining attention. Toshiba Corporation has developed the desktop type industrial computer FA3100TX model 800, which is suitable for edge computing.

Keywords: smart manufacturing, digital transformation, Industrial Computer, edge computing.

1. INTRODUCTION

In recent years, smart manufacturing has garnered attention as a technological approach to addressing labor shortages and facilitating the transition toward carbon neutrality. Smart manufacturing requires digital transformation, which involves the use of IoT (Internet of Things), AI (Artificial Intelligence), and cloud computing. For example, there is a scenario where vast amounts of data generated at manufacturing sites are transmitted to and utilized by the cloud. However, directly sending data collected from sensors to the cloud via the internet can lead to increased network load and latency due to the sheer volume of data. Additionally, transmitting raw data without processing poses significant security risks. Therefore, edge computing, which processes data locally at the manufacturing site and sends only valuable data to the cloud system to reduce network load, is gaining attention.

2. EDGE COMPUTING

Traditional OT systems are typically structured in a hierarchical manner (Fig.1). At the lower level, field equipment and sensors detect physical quantities. These devices are controlled by DCS (Distributed Control System) and PLC (Programmable Logic Controller) connected via field networks. At the higher level, MES (Manufacturing Execution System), ERP (Enterprise Resource Planning), and SCM (Supply Chain Management) manage long-term operations. In recent years, attention has been focused on cloud systems that integrate and manage data collected by each monitoring and control system (Fig.2). This is because timely and accurate management decisions can be made by utilizing data collected and analyzed at lower levels in real time. However, collecting and analyzing all data from field equipment in a cloud system can cause problems with

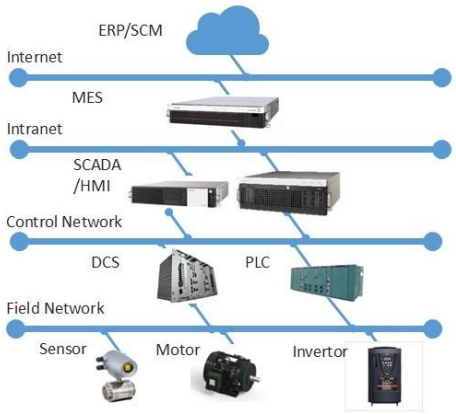

Fig. 1 Traditional OT System

connectivity, bandwidth, latency. To solve this problem, edge computing has been proposed to support data processing at the field level.

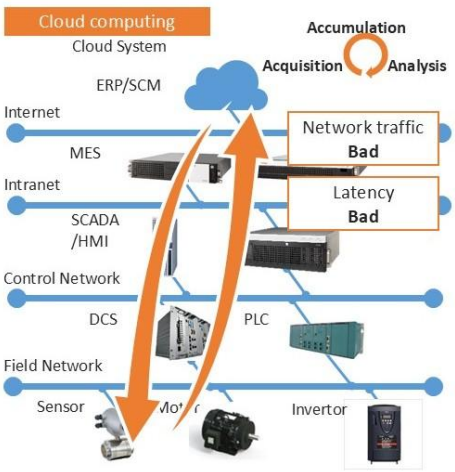

Fig. 2 Cloud Computing

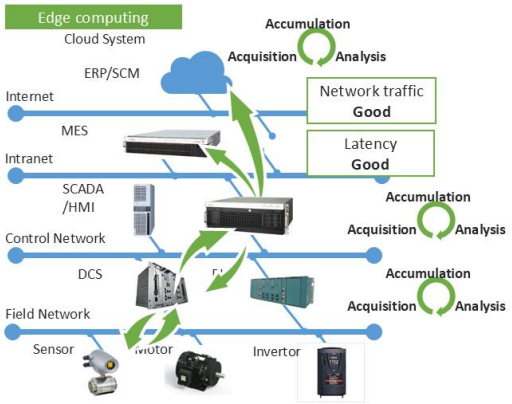

Fig. 3 Edge Computing

Edge computing processes data locally and transmits only essential analysis results to the cloud, reducing latency and network traffic (Fig.3). In addition to these benefits, manufacturing sites require scalability to enable the connection of multiple sensing devices, as well as high reliability and robustness to operate normally in harsh environmental conditions such as high temperature and humidity, dust, vibration, and shock. Recently, edge AI, which performs AI processing such as learning and inference on-site as part of edge computing, has gained attention. Components used in edge computing require high processing performance to alleviate the load on the cloud system, as well as reliability and robustness to withstand use in manufacturing environments.

3. DESKTOP TYPE INDUSTRIAL COMPUTER FA3100TX

Toshiba Corporation has developed the FA3100TX model 800, a desktop industrial computer optimized for components used in edge computing (Fig.4). It is equipped with a high-performance CPU and offers expandability to accommodate multiple expansion boards. To reduce system downtime, it provides storage redundancy through a RAID (Redundant Array of Independent Disks) configuration and monitors the operation of the main unit via RAS (Reliability, Availability, Serviceability) functions. Furthermore, it has higher environmental resistance than general-purpose PCs so that it can operate normally even in harsh environments, making it suitable for use as a monitoring terminal in control systems and information processing terminals operating close to on-site equipment. The specifications are shown in Table 1.

Fig. 4 Desktop type industrial computer FA3100TX

Table 1 FA3100TX Specifications

		Specification
Processor		Intel® Xeon® W-1270TE 2.0GHz
No. of cores/No. of threads		8/16
Chipset		Intel® Chipset W480E
Main memory		DDR4 SDRAM (DDR4-2933/PC4-23400) Max 32 GB / Min 8 GB ECC
Storage		Single disk configuration (MAX 2 units) 2.5-inch SATA SSD unit 128 GB/512 GB 3.5-inch SATA HDD unit 4 TB RAID configuration (MAX 3 units) 2.5-inch SATA SSD unit 160 GB/400 GB 3.5-inch SATA HDD unit 500 GB/4 TB
RAID		RAID1, RAID1+HS (Hot Spare Disk), RAID5
Expansion interface		PCI Express 3.0 (x16): Full size x1 slot PCI Express 3.0 (x4): Full size*1 x1 slot, Half size*2 x1 slot PCI (5V/32bits): Full size x4 slots *1 uses PCI Express(x16) connector *2 In case of RAID configuration, it is occupied by the RAID controller
Interface		COM: RS-232C (D-Sub 9pin x2) LAN: 1000BASE-T / 100BASE-TX / 10BASE-T (RJ45 x4) USB: USB 5Gbps (Type A x6) Graphics: VGA (mini D-sub 15 pin x1), DisplayPort (x1) Audio: LINE OUT (φ3.5mm mini jack x1) DI/DO: DI 4points, DO 4points, remote input 1points (half pitch 20pins x1)
Power supply		Rated voltage: AC100V-240V Allowable frequency: 50Hz/60Hz
Dimensions		430 (W) x 170 (H) x 460 (D) mm (excluding protrusions)
Installation	Temperature	In operation: 5°C - 40°C In storage: -10°C - 50°C
	Vibration	In operation: 4.9m/s^2 or less (installed only SSD) 2.0m/s^2 or less (installed HDD) In package: 19.6m/s^2 or less
Software (OS)		Windows® 10 IoT Enterprise 2019 LTSC (English or Japanese selectable) Windows® 10 IoT Enterprise 2021 LTSC (English or Japanese selectable) Windows® 11 IoT Enterprise LTSC 2024 (English or Japanese selectable) *1 Windows Server® IoT 2019 Standard (English version/Japanese version) Windows Server® IoT 2022 Standard (English version/Japanese version) MIRACLE LINUX 8.6 MIRACLE LINUX 9.4 *1 Planned for future release

3.1 Processing performance

This model is equipped with a 10th-generation Intel® Xeon® W-1270TE processor (2.0GHz, 8cores), delivering workstation-class high processing performance. This enables advanced data processing and analysis to be performed directly on-site.

3.2 Support for high-resolution output

This model includes a DisplayPort graphics interface that supports a maximum resolution of 3840×2160 4K UHD (Ultra High Definition). It also supports the MST (Multi Stream Transport) function, which transmits signals from one DisplayPort output to multiple displays via a daisy-chain connection. These capabilities make it suitable for systems that require high-definition large-screen displays as monitoring terminals.

3.3 High-capacity storage

With the increasing volume of data collected at the field level, large-capacity storage is required. This model can be equipped with 4TB HDD units (hot swappable) up to three and supports RAID1 and RAID5. Therefore, it is possible to configure an appropriate redundant system depending on the application to protect data. Additionally, in RAID1, the third HDD can be configured as a hot spare, preventing single-drive operation until the failed drive is replaced and allowing maintenance to be performed without compromising system reliability. For applications requiring responsiveness, SSDs (hot swappable) can be selected.

3.4 RAS function

The RAS function is composed of dedicated hardware and support software, and includes capabilities such as internal state detection, hardware control, and operation status monitoring. This allows for early detection of the cause of failures and contributes to reducing downtime. As a result, the system achieves high operational availability, which is essential for edge computing environments.

3.5 Expandability

This model can be installed with up to three PCI Express expansion boards. One of these slots supports full-sized PCI Express (x16) expansion boards. This allows for the installation of high-performance GPU (Graphic Processing Unit) boards, enabling edge AI for tasks such as inference on-site. This model can also be installed with up to four PCI expansion boards (Fig.5), meeting the needs of legacy devices. Therefore, even existing equipment that requires legacy interfaces can collect data and achieve digitalization using modern communication protocols such as OPC-UA.

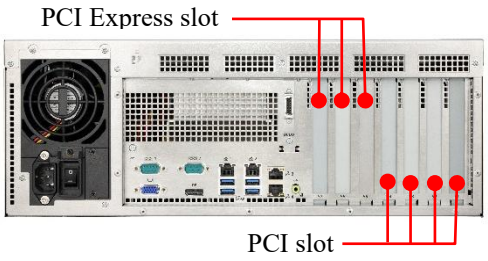

Fig. 5 High expandability

3.6 Environmental Performance

This model offers a higher environmental resistance than general-purpose PCs, thanks to an integrated design approach that optimizes both the chassis and circuit boards to withstand high temperatures, vibrations, shocks, dust, and external noise. This ensures stable operation even in harsh environments such as manufacturing sites.

3.7 Advantages of Long-Term Operation

In long-term system operation, maintenance and replacement of components are essential. This model is designed to minimize system downtime during maintenance by allowing the replacement of life-limited parts such as Storage units (HDD or SSD), CMOS battery and cooling fans from the front of the unit (Fig.6). Furthermore, by selecting long-term supply parts and transitioning to alternatives for EOL (End of Life) parts, the supply period is five years from product release, and the maintenance period is seven years after the end of the supply period (up to ten years with optional extensions). This reduces the frequency of replacements. The pre-installed OS is Windows® IoT Enterprise LTSC series, which is known for its fixed version and long-term support. This ensures stable system operation over extended periods.

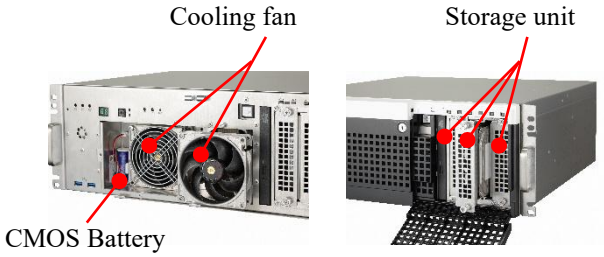

Fig. 6 Example of front maintenance

3.8 Security

As physical security measures, in addition to a security lock slot function to prevent theft of the main unit, which is also installed in general-purpose PCs, it is equipped with a front panel key lock function to prevent unauthorized access to the front POWER button, optical drive, storage drive units, and USB connector. For software-based protection, the secure boot feature safeguards the system from startup through OS boot. While the OS is running, unauthorized access and malware infections can be prevented by whitelist-based security software (available as an option).

4. USE CASE

4.1 Optimizing the manufacturing environment

Traditionally, monitoring and control of power consumption at manufacturing sites have been performed manually or using timers. In contrast, edge computing enables real-time monitoring and analysis of power usage

for each piece of equipment. By predicting peak demand periods based on historical usage patterns and current conditions, it becomes possible to control the operation of air conditioning systems to suppress peak power consumption. Furthermore, energy savings and cost reductions can be achieved by automatically turning off standby power and analyzing equipment efficiency. Automating energy management tasks also reduces the burden on personnel with specialized expertise and contributes to addressing labor shortages. The FA3100TX is equipped with four built-in LAN ports and supports up to three PCI Express expansion slots and four PCI expansion slots. As a result, it can connect to a wide range of equipment-from the latest devices to legacy systems that have been in use for many years-and perform data collection, monitoring, and analysis as an edge computing component. In addition, the FA3100TX is capable of stable operation even in harsh environments typically found in manufacturing sites, such as minor vibrations and dust. By minimizing communication with the cloud, edge computing enables immediate decision-making and control on-site, ensuring stable operation without being affected by communication delays or network failures.

4.2 Product appearance inspection using Edge AI

Traditionally, product quality inspection on manufacturing lines has been conducted manually through visual checks by human operators. By leveraging edge AI, however, it is expected not only to reduce labor requirements but also to improve inspection speed and accuracy. A product classification model trained in the cloud can be deployed to the edge, where image data of the product—captured by a camera—is processed by the FA3100TX industrial computer equipped with a GPU board to perform inference. The FA3100TX supports full-sized, high-performance GPU boards via PCI Express (x16), enabling highly responsive, real-time inference processing. By performing inference locally at the edge, there is no need to transmit inspection data to the cloud, ensuring fast response times while reducing network load and communication costs. Furthermore, by completing the processing within the device without transmitting sensitive data externally, the risk of information leakage can be significantly minimized.

5. CONCLUSION

Toshiba Corporation has developed the desktop type industrial computer FA3100TX model 800, which is ideal for edge computing to realize smart manufacturing. We will continue to provide the components necessary to realize smart manufacturing.

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