ATCA Server Systems for Telecommunications Services

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Internet protocol (IP) networks have evolved to provide higher speed and greater bandwidth more safely and economically and will provide the foundations for a wide diversity of services in the future. A key consideration in the construction of new systems is to enable these new services to be deployed rapidly while at the same time ensuring that networks expand smoothly and remain compatible with inherited assets. The PICMG3.0 Advanced Telecom Computing Architecture (ATCA) is an international open standard that was primarily established to respond to the needs of telecommunications carriers. Fujitsu provides hardware and middleware products that comply with this specification as a platform for the construction of future IP network services, starting with the UB300 series of network service infrastructure products, and has already put them to use in commercial systems. This paper introduces the latest ATCA-compliant model, focusing on the hardware platform provided by Fujitsu.

1. Introduction

The growth of the Internet and the emergence of new services such as video services are causing an explosive increase in traffic on the Internet and mobile networks. Keeping up with these trends requires faster processing speeds in the upper layers, increased network speed and capacity, and the ability to construct service applications quickly and economically. To support these developments, a new platform is needed. Fujitsu has developed server systems that conform to the Advanced Telecom Computing Architecture (ATCA), which is an international open standard primarily established to respond to the needs of telecommunications carriers. Fujitsu's S2 ATCA Server System (hereinafter, ATCA-S2) facilitates the speedy and economical construction of communication systems adapted to diverse services by processing Internet protocol (IP) packets at high speed and enables these services to operate reliably, safely, and economically.

This paper introduces the basic hardware specifications of Fujitsu's line-up of ATCA systems and describes the hardware configuration of the latest model (ATCA-S2) and the features of each product.

2. Hardware features of ATCA servers

Fujitsu's ATCA server system products adhere to four criteria to facilitate the speedy development and smooth introduction of communication systems and make the maintenance and operation of these systems more secure and less expensive:

1) Compliance with global standards for telecommunication equipment

In accordance with the standard PICMG3.0 ATCA developed by the Peripheral Component Interconnect Industrial Computer Manufacturers Group (PICMG), Fujitsu's ATCA servers

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support the inheritance of architecture between generations (backward compatibility with legacy resources), have a unified architecture to make the servers simpler to operate and reduce the cost of materials and maintenance (low maintenance costs), and use third-party vendor materials (for a shorter service development period).

2)   Eco-performance

In addition to the ATCA standard, these products also comply with Fujitsu's green procurement standard. They feature reduced power consumption (operating costs): the maximum blade power consumption is 200 W. They are environmentally friendly: compliant with RoHS (Restriction of Hazardous Substances Directive; an EC directive).

3)   Carrier-grade environmental resistance and durability

They conform to environmental standards for telecom provider equipment. The earthquake resistance complies with NEBS Level 3 (NEBS: network equipment building system). They can operate at temperatures from 5 to 40°C (or 0–50°C for short-term exposure ≤ 72 hours) and humidity from 5 to 85% (or 5–90% for short-term exposure ≤ 72 hours). Their radio frequency interference complies with VCCI Class A (VCCI: Voluntary Control Council for Interference by Information Technology Equipment).

4)   Long-term product delivery and support

Application resources developed by customers can be used effectively for a long time. This offers reduced life cycle costs, i.e., long-term delivery (uses components that are either available over the long term or are highly interchangeable) and smooth equipment introduction planning, i.e., long-term support (uses long-life components that can withstand ten years of use).

3. ATCA-S2 hardware configuration

The ATCA-S2 was developed to comply with ATCA specifications that were drawn up

for hardware to be used in a communications carrier environment. It comprises the following components. Although the way in which the component functions are implemented generally varies depending on the vendor providing the product, it is possible to construct systems by combining components whose mounting and electrical conditions have been standardized (**Figure 1**).

1)   Blades

A variety of blades can be combined to construct hardware platforms for diverse communication systems.

· Single-board computer: Central processing unit (CPU) blade

· Packet processing board: Packet processing blade

· Switch board: Layer-2 hub

· Storage board: Blade with hard disk drive (HDD) mounted on it

· Media board: Media processing blade

2)   Rear transition module (RTM)

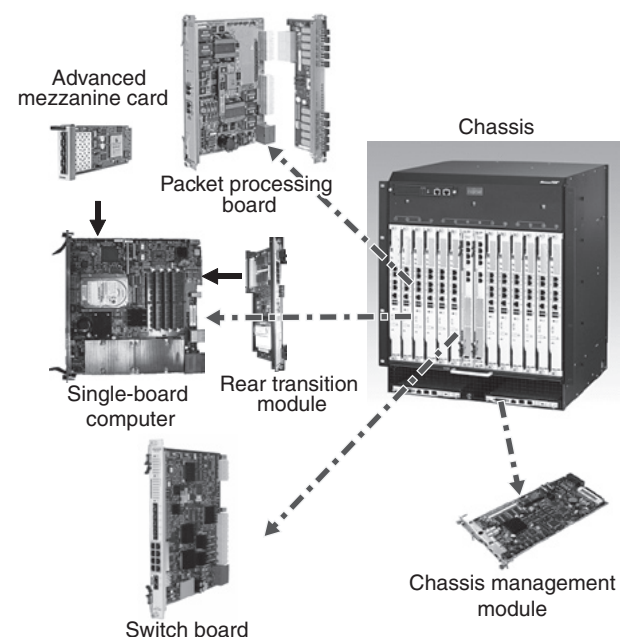HDDs and input/output (I/O) resources such as fiber channels and IP circuits are implemented

Figure 1
ATCA-S2 hardware components.

as extension modules, which are provided in pairs with the blades.

3) Advanced mezzanine card (AMC)

This is a blade-mounted mezzanine card that can accommodate various cards according to requirements to provide a more feature-rich hardware platform. For example, it can accommodate synchronous and asynchronous transfer mode (STM and ATM) termination line cards and IP line expansion cards.

4) Chassis

This is the framework on which the units are mounted. Although different manufacturers have produced units of different sizes, Fujitsu's line-up consists of a 13 U-size unit that can accommodate 14 slots for the largest configurations and a 2 U-size unit that can accommodate two slots for the smallest configurations.

For interface signals such as the internal local area network (LAN) and Intelligent Platform Management Bus, a dual-star redundant wiring configuration is provided so that a signal line fault in a specific component is prevented from affecting the other components. It is also possible to continue providing services by means of system switching to eliminate the defective component.

5) Chassis management module

This controls and monitors the status of each unit. It has an active/standby (ACT/STBY) redundant configuration (when two units are mounted) and uses autonomous ACT switching when a fault is detected.

4. ATCA-S2 blade server

The ATCA-S2 blade server consists of a chassis (14- or 2-slot type), switch blades, server blades, and packet processing blades. The features of these parts are introduced below.

4.1 ATCA-S2 chassis (14-slot type)

The ATCA-S2 chassis (14-slot type, **Figure 2**) can accommodate one or more of the following components: backplane, power supply, and management module; it can also

Figure 2
ATCA-S2 chassis (14-slot type).

accommodate optional ATCA-S2 server and switch blades. Its features include the following:

1) High reliability
· Dual power supplies and a redundant power configuration are provided as standard.
· The backplane is configured entirely from passive components and has a low failure rate.
· Cooling fans, filters, and up to two management modules are redundantly configured and can be replaced without stopping the system when a fault occurs (hot-swappable).

2) Space
· Height: 13 U; can be mounted in a standard 19-inch Fujitsu rack.

3) Number of installable blades
· Up to 12 server blades and up to 2 switch blades.

4) LAN wiring

The base and fabric interfaces are connected to the switch blade in a dual star wiring configuration via the backplane. Blades can communicate via 10 Gigabit Ethernet (10GbE) links within the chassis (we plan to make the backplane of the fabric interface compatible with speeds of up to 40GbE).

4.2 ATCA-S2 chassis (2-slot type)

The ATCA-S2 chassis (2-slot type, **Figure 3**) can accommodate one or more of the following components: backplane, power supply, and management module. It can also accommodate ATCA-S2 server blades, but unlike the 14-slot type, this chassis does not accommodate switch blades. If a base interface hub is incorporated inside the chassis, one can configure a simpler duplex system with two blades.

1) High reliability
· Dual power supplies and a redundant power configuration are provided as standard.
· The backplane is configured entirely from passive components and has a low failure rate.
· Cooling fans, filters, and the hub are redundantly configured and can be replaced without stopping the system when a fault occurs (hot-swappable).
· Up to two management modules can be redundantly configured.
· If the system is rack mounted, ventilation guides can be fitted to enable front-to-back ventilation.
2) Space
· Height: 2 U (3 U with ventilation guides fitted); 19-inch rack-mounted
3) Number of installable blades
· Up to 2 server blades.
4) LAN wiring
· The fabric back plane connects directly between blades and is compatible with speeds of up to 10GbE.
· A base backplane hub can be installed

(duplex) to provide external connections via the hub.

4.3 ATCA-S2 switch blade

The ATCA-S2 switch blade (**Figure 4**) is a LAN switch that implements high-speed communication between ATCA-S2 server blades and with external networks.

1) Performance
· Fabric interface 10GbE-compatible Layer-2 switch
· Full-wire-speed connections
· VLAN (virtual LAN) compatible
· External base:
  1GbE × 3 (RJ45) and 10GbE × 1 (SFP+; a version of SFP [small form-factor pluggable])
· External fabric:
  1GbE (SFP) or 10GbE (SFP+) × 6
2) Expandability
· Base: 1GbE × 6, 10GbE × 1; fabric: 10GbE × 1
3) Maintainability
· Blade units are hot-swappable. To prevent mistakes, a light emitting diode (LED) indicates the blade to be swapped out.
· A serial port and 100BASE-T interface are provided for management (support for remote maintenance/debugging).

Figure 3
ATCA-S2 chassis (2-slot type).

Figure 4
ATCA-S2 switch blade.

- The LAN status can be fully diagnosed from the LEDs on the front panel.

4.4 ATCA-S2 server blade

The ATCA-S2 server blade (**Figure 5**) is a board-type computer on which the ATCA-S2 service middleware and applications are installed.

1) Performance
- Uses an Intel Xeon L5518 (Nehalem Quad Core 2.13 GHz) processor.
- Capable of running eight threads in parallel by means of hyper-threading.
- The CPU incorporates a memory controller, so the memory is connected directly to the CPU.
- The main memory consists of DDR3 SDRAM (double-data-rate three synchronous dynamic random access memory) with error correcting code (ECC) and uses triple channels to increase the processing speed (maximum: 32 GB).

2) Expandability
- Equipped with one AMC slot
- The RTM board is fitted with a 147- or 300-GB SAS (serial attached small computer system interface) HDD and with an external SAS interface (two ports).
- The Fibre Channel RTM board has fiber channels (up to 8 GB) on two ports and can be connected to high-capacity storage devices such as Fujitsu's ETERNUS storage products.

3) Power savings
- Low-power-consuming design with a maximum consumption of 163 W (including the RTM).
- Equipped with a CPU that has power-saving features that almost completely eliminate power consumption in idle cores.

4) High reliability
- Equipped with a SAS HDD (guaranteed 24-hour operation, longer life than an IDE [integrated drive electronics] type, low failure rate).
- The power supply lines from the chassis and the control bus from the management module are redundantly configured.

5) Maintainability
- Blade units are hot-swappable. If a fault occurs, the faulty blade is indicated by an LED, which prevents mistakes.
- A serial port and 100BASE-T interface are provided for management (support for remote maintenance/debugging).
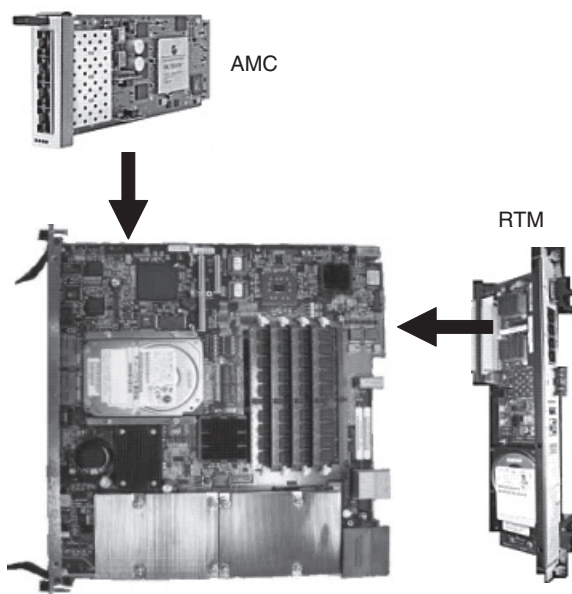
4.5 ATCA-S2 packet processing blade

The ATCA-S2 packet processing blade (**Figure 6**) is equipped with a network processor (NWP) that provides excellent communication expandability and wire-speed packet processing performance.

1) High performance
- NWP suitable for packet processing: Equipped with two Cavium OCTEON Plus 5860 processors (750 MHz).
- 32 cores, capable of running 32 threads in parallel.
- Fitted with hardware accelerators for deep

AMC

RTM

Figure 5
ATCA-S2 server blade.

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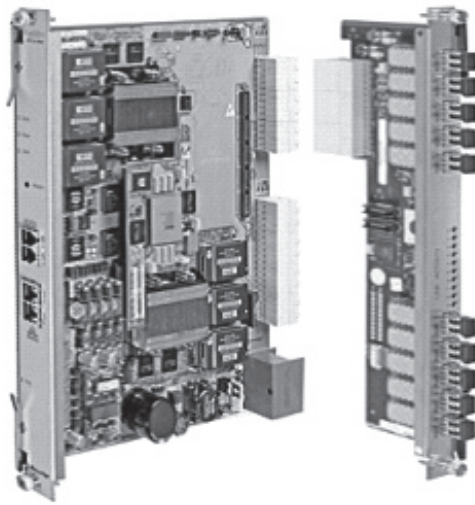
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Figure 6
ATCA-S2 packet processing blade.

packet inspection (DPI) and transmission control protocol (TCP) processing to accelerate the handling of packets.
2) Expandability
· Front panel fitted with 10GbE (SFP+) × 4 and 1GbE (SFP) × 6.
· The 10GbE interface can be operated as a 1000BASE-T (RJ45) with the installation of a 1-Gb/s SFP (up to ten 1GbE lines can be connected).
· The addition of a packet processing blade S2 RTM (release date pending) will allow the system to be expanded by 1GbE × 16 or 10GbE × 4.
3) High reliability
· The power supply lines from the chassis and the control bus from the management module are redundantly configured.
· Equipped with a local management processor (LMP) to monitor NWP faults.
4) Maintainability
· Blade units are hot-swappable. If a fault occurs, the faulty blade is indicated by an LED, which prevents mistakes.
· The NWP and LMP both have their own management serial ports (the LMP is also fitted with a 100BASE-T interface).

5. ATCA-S2's applicable areas

The ATCA-S2 is regarded as suitable for applications in three main areas, where its hardware performance, operability, and reliability can be utilized.
1) Where systems must be introduced and operated stably for long periods of time while exhibiting the availability and environmental resistance demanded of carrier-grade products.
2) Where packets must be gathered and processed at high speed, such as in packet traffic monitoring and switching.
3) Where large-scale packet flows are controlled at high speed, such as in data centers, businesses, Internet service providers (ISPs), network gateways such as mobile virtual network operators (MVNOs), and IP network nodes such as Long Term Evolution (LTE) nodes.

These systems have also been used outside Japan by defense contractors and the aviation industry (for the provision of in-flight services on passenger jets). In Japan, they are expected to be applied to a variety of new fields.

6. Issues and initiatives

At Fujitsu, we always strive to provide our customers with the quality they need and to rapidly bring out products that meet their requirements. Although the hardware specifications of the ATCA server system comply with PICMG specifications, as mentioned above, the equipment specifications contain inconsistencies in parts that are optional or not specified in detail (such as irregular behavior, especially due to faults). To provide our customers with systems that they can use with peace of mind, the related departments at Fujitsu work closely together so that we can provide third-party product vendors with accurate feedback based on evaluations ranging from the component level to the system level so as to meet strict quality standards of the same

class as the standards for Fujitsu's own products. As regards the functional aspects of our systems, we will continue incorporating the functions required by our customers into our products and developing products that enable us to speedily and dependably provide safe systems to our end users in Japan who demand the best service quality.

7. Conclusion

This paper introduced ATCA-S2, which is the latest model in Fujitsu's line-up of ATCA server systems, particularly with regard to the hardware platform (chassis, switch blades, and server blades). Fujitsu will make the results of this development available as a range of solution products starting with the UB300 series, which is a network service infrastructure product. In the UB300 series, the hardware platforms come with a Linux operating system (Red Hat) installed. If required, custom internal hardware, third-party-vendor hardware, Fujitsu software packages such as Interstage and Symfoware, and independent software vendor (ISV) products can also be provided. We also supply dedicated middleware to achieve availability and operability comparable to that of switching equipment and to achieve speedy implementation of packet services.

In the future, we will continue to provide products flexibly and speedily in order to keep up with the evolution of network technology, while strengthening our links with third-party vendors and maintaining the high quality and cost/performance ratio of our products.

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