Innovative Technologies Realizing Compact PRIMERGY TX120 Server

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The need for internal control in enterprises reflects a growing market demand in recent years for data integrity. In line with this trend, enterprises that previously used PCs for data management are now introducing server systems for centralized data processing. For such introduction, customers tend to rely on three main points in selecting a server: size, low noise, and low power consumption. At the same time, innovations are being made in space-saving technology and low power consumption technology. Given these market trends and technological innovations, Fujitsu has introduced the PRIMERGY TX120 — a compact server that achieves 1) small size, 2) low power consumption, and 3) low noise. The server is so small that it can be installed on a desk next to a desktop PC. It incorporates space-saving technology such as a 2.5-inch hard disk drive (HDD) and component miniaturization, energy saving technology applied to parts that consume low power and a pulse width modulation (PWM) fan, and low-noise technology such as a heatpipe and push-pull fan cooling system. Concerning its reliability as a server, the PRIMERGY TX120 utilizes reliability technology equivalent to that of conventional 1-way servers.

1. Introduction

For PC servers where cost is a priority, cooling systems that employ cooling fans are generally used as the cooling method. In particular, the primary method used to cool the CPU, the main source of heat generation, is mounting a cooling fan directly onto the CPU. However, this poses a large source of noise generation. Moreover, the need for internal control in enterprises reflects a growing market demand in recent years for data integrity. In line with this trend, enterprises that previously used PCs for data management are now thinking about introducing server systems by considering size, low power consumption, and low noise. As such, there have been growing expectations for servers that can satisfy these requirements.

With the emergence of 2.5-inch hard disk drives (HDDs) and CPUs that consume low power, advancements have also been made in miniaturization, low-power consumption, and other innovative technologies.

Given these market trends and technological innovations, and in considering the fact that the base for servers will certainly broaden, Fujitsu has introduced the PRIMERGY TX120[1)] — the world's highest-level, compact-size server (**Figure 1**). The PRIMERGY TX120 achieves small size, low power consumption, and low noise. The server is so small that it can be installed on a desk next to a desktop PC.

This paper introduces the technologies that achieve space savings, energy savings, low noise, and high reliability for the PRIMERGY TX120.

2. Space-saving technology

The PRIMERGY TX120 can be installed in offices having limited space, in stores and shops,

and even on countertops. And when considering the possible replacement of personal computers, the PRIMERGY TX120 has been designed using the dimensions of a desktop PC as its target values. This does not mean, however, that the PRIMERGY TX120 has simply been reduced in size. Because the PRIMERGY TX120 will be used as a server, its specifications have been determined based on investigative results of market trends and customer systems with regard to required server expandability.

1) Utilization of a 2.5-inch SAS HDD

A 2.5-inch enterprise serial attached SCSI (SAS) HDD has been adopted. Compared with a 3.5-inch HDD, the volume of the 2.5-inch HDD has been reduced by approximately 70%. Moreover, in considering the need for hardware RAID for the server, two HDDs have been installed.

2) Miniaturization of the heatsink with heatpipe

The newly developed components have also been miniaturized. In particular, a miniaturized heatsink with heatpipe has been newly developed. This heatsink with a heatpipe achieves cooling capability equivalent to that of Fujitsu's entry 1-way server PRIMERGY TX150 S5, while being reduced in volume by approximately 60%. Moreover, the use of aluminum and copper alloys as component materials has realized a considerable weight reduction.

3) Miniaturization of the power supply unit

A power supply unit that offers increased power efficiency has been newly developed. Compared with the power supply unit mounted in the PRIMERGY TX150 S5, the power supply unit of the PRIMERGY TX120 has been reduced in volume by approximately 40%. The shape of the power supply unit has also been changed. Instead of being a simple rectangular parallelepiped, the power supply unit features an uneven shape that improves the mounting efficiency of other components.

Thanks to the intensive use of these miniaturization technologies, the PRIMERGY TX120 is the same size as a desktop PC measuring only 99 mm wide, 399 mm deep, and 340 mm high. A size comparison with the PRIMERGY TX150 S5 shows that the PRIMERGY TX120 requires less than one-third the installation space, for a volume of less than one-fourth (**Figure 2**).

3. Energy saving technology

The power consumption of a desktop PC was set as the target value for power consumption of the PRIMERGY TX120. To meet this target value, components that consume low power were thoroughly used in the PRIMERGY TX120. For instance, a low-power consumption, dual core, Intel Xeon processor 3000 sequence is used for the CPU (the main source of heat generation). Compared with a conventional Intel Pentium D processor, power consumption has been reduced by up to 30%. By using a pulse width modulation (PWM) fan as the cooling fan, fan rotations can be adjusted to match minute fluctuations in ambient temperature, resulting in energy savings. In addition, the use of low-power-consuming components such as the 2.5-inch HDD has enabled overall server power consumption to be kept within approximately 60% that of a general 1-way server. Thus, by replacing general 1-way servers with the PRIMERGY TX120, a yearly reduction in the amount of CO_2 equivalent to the planting of 31 cedar trees can be achieved.

4. Low-noise technology

Although there have been rapid improvements in CPU performance in recent years, the low-noise technology used in cooling has become a significant problem. Air-cooling systems that employ cooling fans have been used as the cooling method for servers. Such cooling fans, however, are the major source of noise generation. Moreover, efforts to reduce fan noise for achieving lower noise have encountered a technological wall.

1) Heatpipe cooling technology

Figure 1
Compact server PRIMERGY TX120.

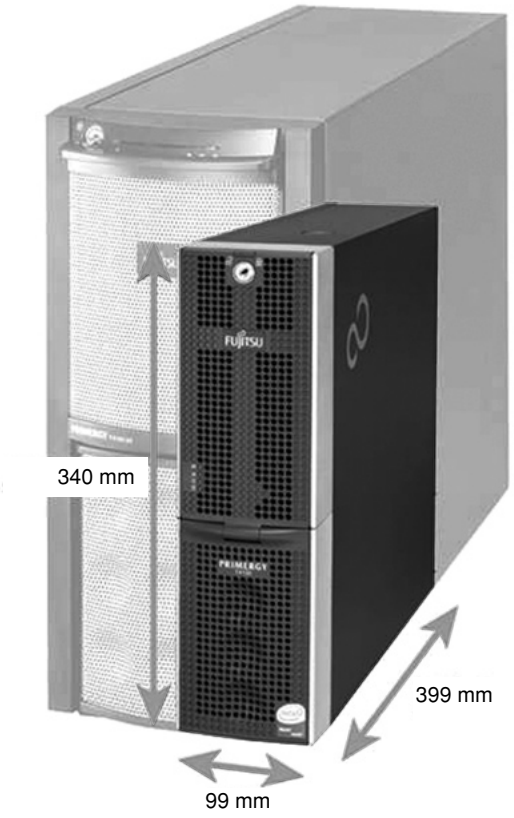

Figure 2
Size comparison of PRIMERGY TX120 and PRIMERGY TX150 S5.

Liquid cooling technology has drawn attention in recent years as low-noise technology for cooling the CPU. Other vendors have incorporated liquid cooling technology for some of their servers. However, liquid cooling technology has had to deal with the problem of leakage.

Fujitsu began using heatpipe cooling technology (**Figure 3**) in 2005, with significant noise reduction being achieved for the PRIMERGY TX150 and PRIMERGY TX200 series. The PRIMERGY TX120 also adopts this heatpipe cooling technology. A metallic pipe that utilizes a capillary phenomenon is used for heatpipe cooling. One end of the pipe is connected to the CPU; the other end is connected to a radiator. This heatpipe cooling mechanism enables heat to be efficiently conducted away from the CPU within a limited space.

2) Straight cooling method

Cooling within the cabinet was also considered. In the straight cooling method (**Figure 4**), the heat sources (CPU, chipsets, and I/O controller) are arranged in a straight line with cooling air blown from the front of the device to the rear to effectively cool the heat sources.

3) Push-pull fan cooling

Generally speaking, decreasing the number of cooling fans — the major source of noise — is one way of reducing noise. Fujitsu, however, has devised a different approach. We increased the number of cooling fans installed, but lowered the fan rotational speed. This constitutes the push-pull fan cooling method (Figure 3) where two fans (one in front and one in back) are used to cool the CPU of the PRIMERGY TX120. The fan in the front pushes the air as the one in the back pulls the air. By installing two cooling fans in this manner, the required airflow for cooling can be effectively maintained, even while reducing the fan rotational speed. As a result, lower noise has been achieved.

Serial ATA (SATA) connections are generally used for connecting the HDDs of desktop

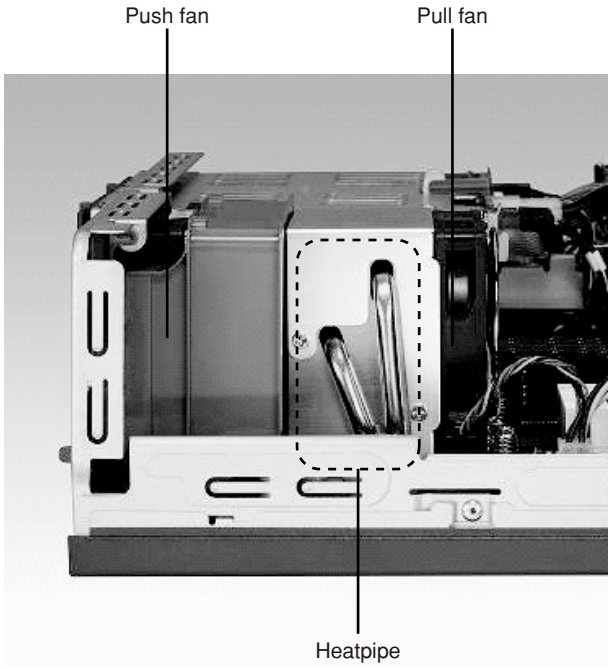

Figure 3
CPU cooling by heatpipe and push-pull fans.

PCs. A SAS HDD spins at 10 000 to 15 000 rpm. In contrast, the SATA HDD spins much slower at 7200 rpm. As a result, lower noise can be expected for SATA connections. To maintain server reliability, however, we employed the highly reliable SAS HDD for the PRIMERGY TX120, while making free use of low-noise technology. Consequently, we have achieved the industry's quietest air-cooled server. Noise measures only 32 dB during operation and 28 dB at standby, or equivalent to a level of a person whispering.[note)]

5. Server reliability technology

Installation of the PRIMERGY TX120 is expected at locations that need to save space, such as in stores, shops, and on counters. The PRIMERGY TX120 is also expected to provide reliability capable of 24/7 operation. This section discusses the technology used to improve the reliability of the PRIMERGY TX120.

note) The 32 dB during operation and 28 dB during standby both conform to ISO7779. Both values were measured by Fujitsu.

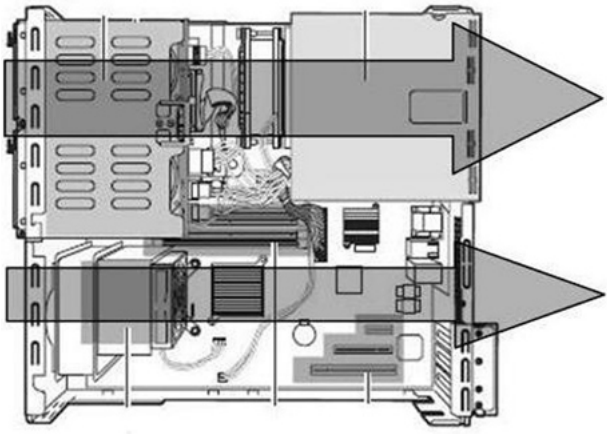

Figure 4
Straight cooling method.

1) Use of enterprise SAS HDDs

The PRIMERGY TX120 adopts an enterprise SAS HDD to achieve stable continuous operation. Hardware RAID is installed as standard, with hot-plugging also supported. Should a HDD fail, the faulty HDD can be replaced without having to stop the system (**Figure 5**).

2) Installation of a backup device

Considering the importance of data stored on a server, the data must be protected by using a backup device. Should an external device be used for backup, however, the overall system will not save space. Therefore, the PRIMERGY TX120 was designed to accommodate the internal installation of a backup device. This enabled the creation of a system that offers higher reliability and which only requires space for the server itself.

3) Installation of a remote control function

To enable management of the server from a remote terminal, a second-generation, highly integrated, single-chip, baseboard management controller (BMC) that supports a graphical remote control function has been installed as standard. Not only can the PRIMERGY TX120 be operated from a remote terminal using the OS screens of the server, such operations as turning on the power supply unit while the

Figure 5
Hot-plug, 2.5-inch, SAS HDD.

server is inactive or setting up BIOS can also be performed from a remote terminal. This remote control function thus allows the server manager to manage the server at remote locations such as in stores or shops, or in company branch offices without having to be physically near the server.

The objective of this remote control function is not simply to enable remote operation. Using this function will eliminate the need for constant display or keyboard connections to the server, thereby further contributing to space savings.

6. Conclusion

This paper has introduced four types of technology used for saving space and energy, achieving low noise, and ensuring server reliability in order to realize the world's highest standard, compact-size server. This paper was written based on the assumption of server use in small and medium-size systems. However, as more servers have been introduced in recent years into the data centers of large corporations, we feel that the technologies described in this paper could be effectively used for servers in general. There are also high expectations for saving energy in rack servers and blade servers. Fujitsu will continue improving these technologies in order to develop the next generation of servers.

Reference

1) Fujitsu: PRIMERGY Compact Size Servers TX120.
http://www.fujitsu.com/global/services/computing/server/ia/compactsizeserver/

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