Express5800 Server Series and iStorage M Series Storages Contributing to Data Center Power Saving

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Abstract

NEC's power-saving Express5800 series servers and iStorage M series storages incorporate a various power-saving technologies. Of these, this paper introduces featured technologies that can protect the power consumption of data centers, such as power supply efficiency improvement, power control and high ambient temperature compatibility solutions.

Keywords

data center, power saving, DC power supply, optimum power supply operation control, power capping, high-efficiency power supply, MAID, high ambient temperature compatibility

1. Introduction

The rapid dissemination of mobile terminals and widespread growth in the corporate use of cloud services in recent years have been promoting concentration of IT equipment to data centers. One of the issues of the data center is how to improve the efficiency of the IT equipment concentration in environments with limited power supplies. It is necessary to reduce the power consumption of the IT equipment in order to solve this issue.

At NEC, we incorporate power-saving technologies in the Express5800 series servers and iStorage M series storages, not only to reduce the power consumption of IT equipment in order to fill the above requirements, but also to reduce the power demand of the entire data center facility.

2. Power-saving Servers

This section introduces some of the Express5800 series power-saving servers, including the ECO CENTER server for data centers and the SIGMABLADE blade server system.

2.1 ECO CENTER

In order to achieve the optimization of data center operation, we have developed the ECO CENTER, in which various power-saving technologies are incorporated. Two of the chosen technologies are discussed below.

(1) 12V DC power supply compatibility

Most of data centers adopt UPS (Uninterruptible Power Supply) countermeasures to deal with issues such as power outages. The UPS converts AC power supply temporarily into DC and stores it in an internal battery. Subsequently, it re-converts the battery power to AC and supplies it to IT equipment such as servers, which then converts the power supply from AC back into DC again for operational use. These conversions between AC and DC are always accompanied by power losses, which means that minimizing the frequency of conversions will lead to power saving.

The latest data centers note the power losses accompanying these AC/DC conversions and adopt 12V DC power supply to the IT equipment in order to reduce the frequency of AC/DC conversions.

In order to provide countermeasures against these chang-

Photo 1 External view of the Express5800/E120d-M.

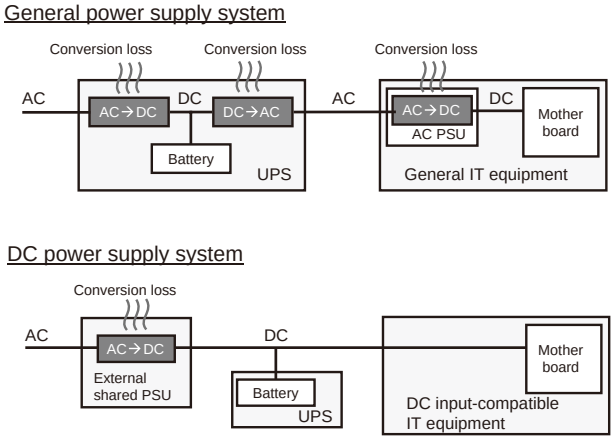

Fig. 1 DC power supply system.

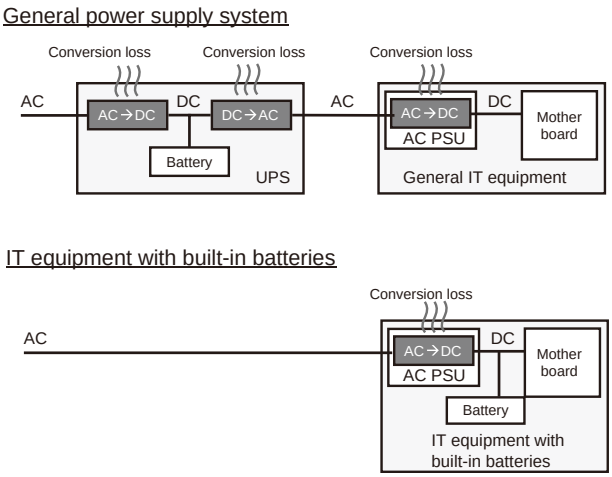

Fig. 2 Power supply system of IT equipment with built-in batteries.

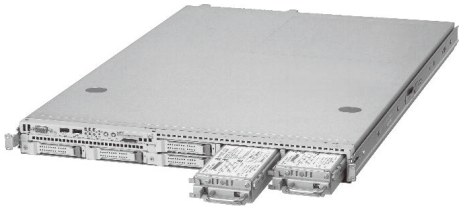

Photo 2 External view of the Express5800/E120d-1 (Model with built-in batteries).

es in the power supply environments of the data center facilities, we commercialized the Express5800/E120d-M 12V DC input compatible server (**Photo 1**) as the ECO CENTER series.

The Express5800/E120d-M is provided with a power option called the 12V DC input module that provides system compatibility with 12V DC power as well as with AC power supply unit. When a 12V DC input module is used, the power fed as 12V DC is sent to the mother board of the server without being converted. In this way, power saving is achieved by a reduction of the frequency of AC/DC conversions (**Fig. 1**). The elimination of power conversions enables the 12V DC input module to adopt an extremely simple architecture. Therefore, the number of fault incidence occurrences in the server can be reduced and consequently it contributes to improvement of availability.

(2) Built-in batteries

Traditional AC power-supplied data centers and server rooms can also reduce the power loss risks caused by AC/DC conversions by introducing IT equipment with built-in batteries.

Incorporating batteries in the IT equipment instead of installing the UPS at the facility side can complete AC/DC conversions with one cycle, as well as reserving backup power to counter power failures (**Fig. 2**). This strategy can save power by up to 5% compared to the ordinary power supply system using the UPS (compared to the system using NEC's UPS).

The Express5800/E120d-1 (model with built-in batteries) can incorporate up to two large-capacity Ni-MH batteries in the server (**Photo 2**). The number of batteries can be selected according to the power consumption of the server.

The Express5800/E120d-1 (model with built-in batteries) installs the batteries at the front of it in order to improve the battery cooling efficiency by permanently feeding fresh air. The result is a long service life of five years, even with an ambient temperature of 30ºC. This model is also very convenient for system management because its standard server management function, the EXPRESS SCOPE engine, performs integrated management tasks that cover the battery status.

As described above, the Express5800/E120d-1 (model with built-in batteries) not only saves power by incorporating batteries but also enables efficient equipment investment according to the customer's business expansion by eliminating the large-sized UPS from the data center facility.

2.2 SIGMABLADE

The SIGMABLADE is a product that combines servers,

networks and storage in a single enclosure. It incorporates the EM Card, which is the module for integrated operation management of the products inside the enclosure. This section describes two of the related energy-saving functions implemented by the EM card.

(1) Optimum power operation control

The enclosure of the SIGMABLADE accommodates up to 16 CPU blades (servers) and 8 network switches. Even if the enclosure has power supply module(s) capable of supplying power even when the maximum number of products is installed, this does not mean that the maximum numbers of CPU blades and switches should always be used. It is acceptable to use only the required number of CPU blades and switches.

In such a case, the AC/DC conversion rates inside the power supply module(s) vary depending on the wattage supplied inside the cabinet, and the EM card applies autonomous judgment to optimize the conversions and switches the power supply module ON/OFF accordingly to save the power required in the operation (**Fig. 3**).

(2) Power capping Technology

This function supports the operation of SIGMABLADE so that the total power per enclosure is limited below the preset power capping value. This makes it possible to continue the system operation without using excessive power when it is required to operate the system efficiently within the limited power supply range of the floor.

Specifically, this function sets the power capping value in the EM card in advance. The EM card monitors the power consumptions of all of the products in the enclosure. If the addition of a CPU board causes the power consumption to exceed the preset power capping value, the EM card autonomously switches the desired CPU blades to the power-save mode in order to reserve the power so that the additional CPU board can be used subject to the preset power capping value (**Fig. 4**).

This function is not restricted to a single enclosure but it is also possible to group more than one SIGMABLADE enclosure and set the power capping of an entire system. In this case, the EM cards inquire the power situations of each other so that the system operation can be continued by managing the power usage of the whole system (**Fig. 5**).

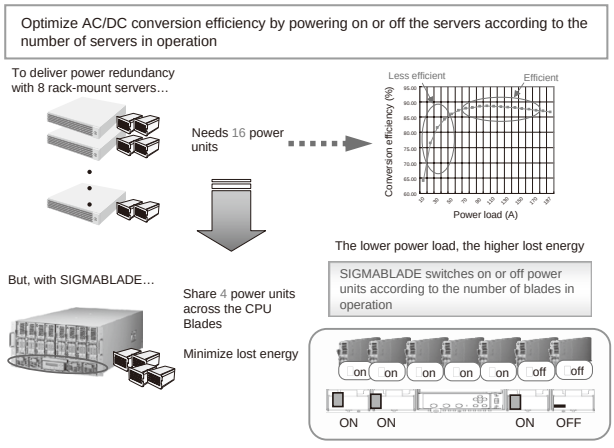

Fig. 3 Optimum power supply operation control (Power ON/OFF according to the number of operating units).

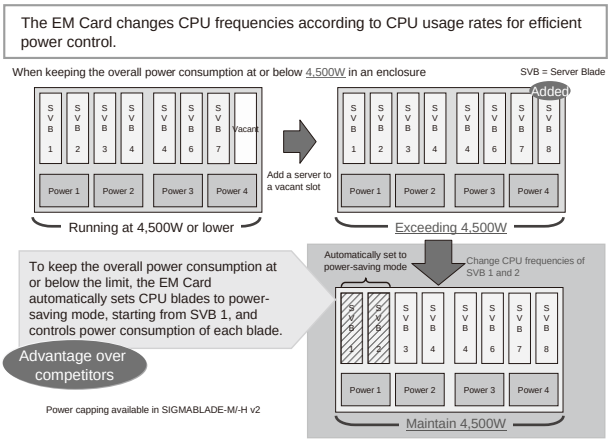

Fig. 4 Power capping.

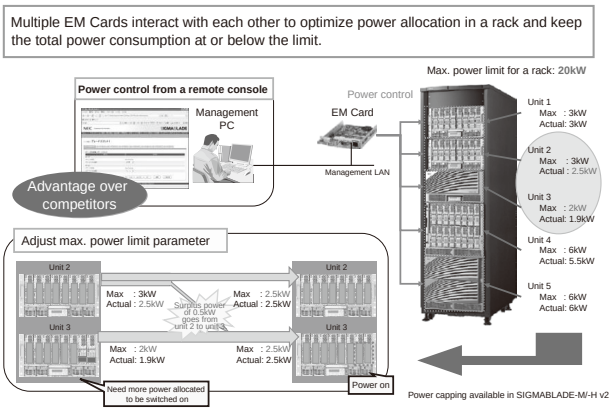

Fig. 5 Inter enclosure power control.

3. Power-saving Storages

The iStorage M series can reduce the power consumption of the storage device itself through the hardware that is effective for power saving. In addition, it has succeeded to incorporating power consumption reduction function by applying our original ideas for controlling storage devices.

(1) High-efficiency power supply

The development of the high-efficiency power supply is an example of effective power saving hardware. The efficiency improvement technology is implemented by

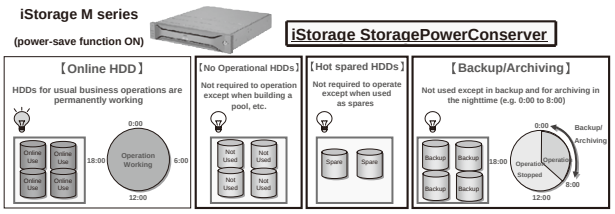

Fig. 6 iStorage StoragePowerConserver.

the use of high-efficiency (soft switching/sync rectifier) circuitry and low-loss chips. Specifically, we have commercialized a world leading AC power supply unit (certified as 80 PLUS GOLD) that provides storages with high efficiency.

(2) 380V HVDC power supply compatibility

We have also developed a 48V DC/380V HVDC power supply unit that is used exclusively in data centers for enabling supply of DC power to storage devices. The high voltage of the 380V HVDC system not only features high efficiency but also provides other advantages, including the possibilities of reducing cable diameters as well as of facilitating the design and construction of the facility.

(3) MAID technology

The iStorage StoragePowerConserver is a function that reduces the power consumption by controlling the storage devices. It achieves energy-saving operations of storages by employing the MAID (Massive Arrays of Inactive Disks) technology that rotates the HDD only when necessary and stops it when it is unnecessary (**Fig. 6**).

This function controls the stop/start of operations of the HDDs mounted in the iStorage M series product by autonomously identifying the HDDs that are not always used according to their properties. A function for controlling the stop/start of the HDDs forming the storage pool to which the logical volume belongs according to their usage situations is also provided for energy-saving operations linked to business operations.

When this function makes it possible to rotate the HDD only as necessary during the backup operation, etc., the power consumption may be reduced by up to 30%.

4. Power Saving by High Ambient Temperature Compatibility

The high ambient temperature compatibility of IT equipment is an important factor in power saving for facility linkages such as for data centers or server rooms.

In general, the upper limit of the operating environment temperatures of traditional servers and storages is 35ºC. NEC has succeeded in raising the upper limit to 40ºC by selecting components and optimizing the air flow design (**Fig. 7**). This has made it possible to raise the air conditioning temperature

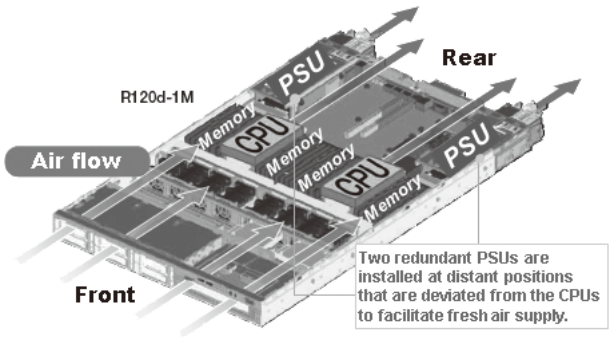

Fig. 7 Cooling structure of high ambient temperature compatible server.

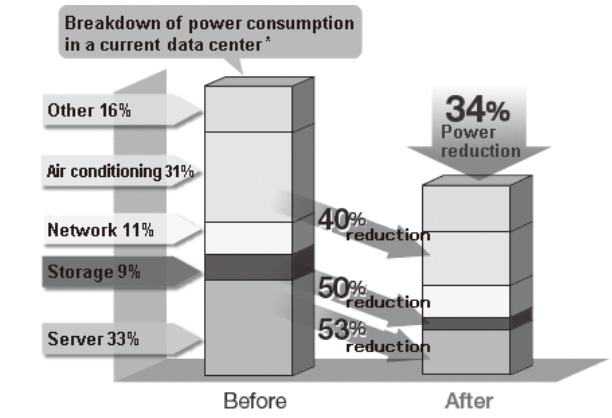

Fig. 8 Power-saving effects of high ambient temperature compatible IT equipment.

of data centers and to thereby reduce their power consumption.

As an example of the effects of power-saving, **Fig. 8** shows the results of trial calculations assuming that a customer is continuing to use IT equipment that was installed in 2007. In this case, replacing the servers and storages with the latest power-saving servers and storages of high ambient temperature compatibility can reduce the power consumption of the IT equipment and the generation of heat; as well as of the power consumed by the air conditioners used for cooling the generated heat. When the reduction of power consumption achieved by raising the air conditioner setting by 5ºC is considered, the total power consumption of the air conditioners can be reduced by about 40% and that of the entire data center can also be reduced by 34% (according to our trial calculations).

5. Conclusion

In the above, we introduced the power saving measures adopted for our servers and storages. In the development of servers and storages of the future, too, we will endeavor to

contribute solutions to social issues associated with the global environment by considering power saving issues. Robust support will be continued in applying the implementation of functions and performances to meet customer needs.

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