Features of NEC’s Server Blades “NEC Express5800/BladeServer”

NEC has developed the high performance and space saving, “NEC Express5800/BladeServer”. The plug-in structure of the server reduces the number of required cables. As well as the server’s high performance, high expandability and high reliability, with its compact body and easy maintenance, the NEC Express5800/BladeServer is able to meet the user’s need of reducing the “total cost of ownership” or “TCO”.

1. Introduction

A typical Internet based network server group is of a 3-layer model comprised of the front-end server group, application server group, and back-end server group. (See figure below.)

[Image of 3-layer model at network server]

Fig. 3-layer model at network server.

Web servers are what we mainly think of when we talk of the front-end server group. It is located at the front end of the Internet, and is comprised of many servers loosely inter-connected on the network. Although the front-end server group does not require high I/O
expandability (excluding network I/O expandability), it does require many servers with the same functions to deliver high performance (scale-out).

The back-end server group is typically comprised of data base servers, which process data after a request from the application server group is received. Both high CPU and high I/O performances are required of these servers due to the sequential processing required for updating databases. Therefore an appropriate approach for enhancing the performance of the back-end server group would be the use of large-scale servers having multiple processors and multiple I/O buses.

The application server group is located in-between the front-end and the back-end server groups. Its main purpose is to execute job applications in conjunction with the 2 server groups.

The “NEC EXPRESS5800/BladeServer” has attained I/O expandability suitable for both front-end and application server groups, thus enhancing packaging density. It is a completely new type of server product, which can meet the performance required for network servers.

2. The Blade Server advantages

The pursuit for the reduction of consumed space derives mainly from the need to reduce TCO, which comes from server operation. Operation cost for servers include floor, electric, and maintenance costs. In data centers, floor costs and maintenance costs combine for a major portion of operation expenses.

With computerization and the spreading of IT into the workplace, the number of servers has been steadily growing. With these servers come management costs. Reportedly, the management cost for a server rack is approximately US$2,000 per month, which amounts to US$120,000 over 5 years. Improving the servers packaging density helps directly reduce floor costs.

Round the clock maintenance is required to steadily run a server 24 hours a day 365 days a year. However, having skilled technicians perform server maintenance, bare extraordinary costs. The need for easy and efficient server management is ever increasing.
The concept of the blade server was developed on the basis of space conservation. Through the sharing of power sources and fans between multiple servers, and easing maintenance by designing main component as plug-in modules, this was made possible.
3. Performance and Expandability

The packaging density is determined by the amount of heat that is released by the machine and also the expandability of the server. A server can be made more compact by limiting expandability, but by doing so, functionality is too limited. The ideal use of the blade server is in the front-end and application layers of the network server construction. According to research, we can conclude that expandability of a system configuration is a necessity.

NEC’s blade server is equipped standard with a 3 port LAN to be used for the Internet, Intranet, and for the administrative systems of a data center. It is also capable of supporting an I/O expansion port to add an additional interface such as a gigabyte Ethernet. With the design centered on expandability, each server of the blade server is equipped with 2 X 3.5 inch HDD, (hard disk drives) and 2 USB ports.

Another problem that must be addressed when compacting the sizes of servers, are the amount of heat that is generated. Simply by changing the CPU to a more power efficient model, and simplifying the cooling mechanism in today’s new servers, we could pack the devices into a more compact body. But to reduce the power consumption, a reduction in the drive voltage is necessary, as well as a selection of a lower voltage operable LSI. These reductions, unfortunately, tend to lower CPU clock speeds, as well as come with a high price tag. According to interviews, users will not sacrifice performance to attain compactness.

To resolve these problems, NEC’s blade server incorporates 2 X Pentium III 1.26 GHz processors (equivalent to those used in general-purpose servers), per server to maintain compactness, and at the same time retain performance. To cool off the large amount of heat generated by the CPUs, 2 sets of redundant fans are provided, both at the front and back ends of the machine cabinet. This allows our blade server to operate normally, up to the same 35 C degrees, that the general-purpose servers do.

4. Space Saving Design

The term “Space-Saving”, which is discussed in this section, refers to the efficient loading of required devices into a confined space, without loosing or removing any functionality. The blade was intended to be a new type of product. So, there were no given form factors or size restrictions when it was designed. The only restrictions were as follows:
(1) The structure and size should not be too extreme resulting from the pursuit of high reliability, high expandability, and efficient cooling mechanism.
(2) The blade server must be more densely and efficiently packed into the chassis compared to the general-purpose 1U/2U machines.
(3) The impact of the initial introduction costs must be kept at a minimum.

Instead of just loading multiple servers into one body and reducing the price by the sharing of common parts, we felt it was more important to reduce the overall price of initial introduction of multiple blade servers (2 or 3).

To meet the above mentioned requirements, we decided to load 6 servers into a 3U body, and locate the 3.5 inch HDD at the front end of the chassis, and the CPU “blades” and power supply in the back (see below). The width of each CPU blade is 1.6 inches, which allows for the high-performance Pentium III 1.26 GHz processors to be installed. In addition, the PCI cards are installed away from the CPU’s radiating fins to achieve both high performance and expandability, in a minimum amount of space.

![Blade Server chassis.](image_url)
5. Achievement of High Reliability

Reliability is an important factor to consider when constructing servers. Specifically, in this case, the power supply and fans, which are shared by the multiple servers, must be as trouble free as possible. If a failure were to occur at one of these locations, it may cause the other servers to go down simultaneously.

Ideally, fans should be installed inside the cabinet. However, with the blade server, the fans were consciously designed at the front and back ends of the chassis, to allow for defective fans to be replaced easily, without stopping server operations. With this design, if either of the duplicated redundant fans were to fail, it can be replaced without stopping operations.

An optional power supply can be added to provide for a redundant configuration. If a power supply were to become faulty, it can be replaced without stopping server operations (hot plug). Furthermore, no active devices are connected to the back plane where the CPU blade and the HDDs are connected to maximize reliability.

Each of the servers is designed for the highest reliability. Unlike other companies’ blade servers that use 2.5 inch HDD, which are known to have long-term reliability issues, the NEC blade server uses the 3.5 inch HDD with a proven track record in the general-purpose server. In addition, disk redundancy can be improved by software mirroring of the 2 HDDs.

For memory, ECC memory is loaded to help prevent server failure due to memory problems.

6. Improvement in Maintainability

Main components have been constructed as plug-in modules for easy replacement and expansion. The plug-in module structure has the following advantages:

(1) Each module allows for hot plug and removal. Therefore it can be serviced without stopping the other servers in the same chassis.
(2) The components inside the machine can be accessed without removing the chassis out of the rack (front and rear access). Less removal during maintenance results in less wear-and-tear to attached cables.
(3) LAN cables are routed separately from the harness via the back panel. A reduction in the number of cables can reduces the time required for on-site adjustments.
There is no need to disconnect and reconnect the cables during individual CPU blade maintenance (when there is no expansion board), which will lessen the probability of incorrect insertion of cables.

The CPU blade and HDDs can be replaced separately, therefore reducing maintenance time.

With these benefits, on-site adjustments and maintenance costs are lower than those of general-purpose servers. (The on-site adjustment cost is proportional to the number of units that can accommodate six servers. The more servers, the less the on-site adjustment cost.) This reduction of on-site adjustment cost has a great influence on the price of the system, especially when the system scale is large.

7. Achieving High Serviceability

With the integration of multiple servers, the blade server can bring about the above-mentioned benefits. However, this integration of servers gives rise to new problems. Key components for solving these problems are the NEC ESMPRO management software programs. A brief description is given below.

7.1 Efficient OS Installation for Multiple Servers

Operating systems must be installed in each individual server. The installation will require network OS installation without the CD-ROM and FDD devices available as options.

NEC ESMPRO/Deployment Manager can carry out OS installation, BIOS updating, and offline diagnostics of individual servers according to need.

The user can select either of the two installation methods. The first is a method in which the OS is installed from a virtual CD-ROM over the network according to a configured setting. The second is a method in which preinstalled media images are used.

7.2 Reinforced Remote Monitoring and Maintenance Functions

The existing Express servers support the NEC ESMPRO Manager and ESMPRO Agent that can remotely monitor the status of servers and help prevent server failures.
The new blade server has a reinforced remote monitoring capability that can manage the individual blade servers that are arranged in a tree structure based on the “cabinet” layers.

When the OS starts, the NEC ESMPRO Agent collects and sorts the information of the server. Even when the OS is absent, the BMC (Baseboard Management Controller) can take over the monitoring functions.

In an environment with multiple servers, it is important to select the right server to service. Although dispatching a skilled technician can prevent the occurrence of these problems, it is impossible to ask a skilled technician to be on standby 24-hours a day due to the enormous cost which will result. To solve this problem, we have adopted a system that allows even an unskilled person, by contacting the remote maintenance center, to locate the server to service.

At the maintenance center, through the NEC ESMPRO Manager, the administrator can monitor and detect which server is having a problem. They then are able to activate an ID LED on the on-site machine. The ID LED is located at the front-end of the blade server cabinet, signifying which machine is having the problem, as well as individual LEDs located at the rear, signifying to the maintenance personnel which CPU blade is defective.

Upon finding the lit ID LED, the maintenance personnel can press the Notify switch on the defective server, whereby notifying to the administrator in the maintenance center which machine has been recognized as being defective. The administrator then verifies if the correct machine has been chosen. This process can help eliminate the possibilities of incorrect selection of the faulted machine.

In addition to the functions of the above NEC ESMPRO administrative software programs, the NEC blade server is equipped with a “BMC” (administrator-dedicated processor) in each blade, so that servers can be controlled from an administrative machine across the network even when there is an absence of an OS or the servers are not powered on.

Having administrative processors on each blade has the following merits over providing a single representative administrative processor for the whole cabinet:

(1) A problem occurring in the administrative processor would affect only the individual server, and minimize the range of the problem.

(2) Distributed administrative processors can flexibly cope with varied types of blade servers.
(3) Initial costs are reduced.

The BMC of the individual servers are interconnected through the ICMB bus, through which detailed information, such as blade local information, can be collected.

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