WHITE PAPER

NEC Express5800/Blade server – Cooling technology

Express5800/BladeServer has a characteristic in implementation technology to pack six servers in 4U size enclosure which are mounted in a general purpose 10 inch-rack. Each blade has two hot swappable SCSI HDD, and single accessory slot compatible with PCI-X. In order to strike a balance between high power consumption CPU and high density implementation, innovation of cooling technology is necessary.

NEC Blade server which has accessory slot compatible with two hot swappable SCSI HDDs, PCIIX per the blade has a disadvantageous specification on the cooling side. In a rack mount model server including a blade server, air intake and exhaust stream area is limited to the front-side and back-side of chassis. But this limited area is blocked up with HDD and PCI-X compatible accessory slot, and Midplane to connect HDD and Blade prevents an air flow more (cf. Fig. 1).

In addition to this, of which CPU power consumption increased twice as high as ex-model of machines, the new model should double the cooling performance (cf. Fig. 2).
In this disadvantageous condition, environmental temperature of more than 35 degrees (the same as the general-purpose rack mount model server), cooling redundant (even if its one of fans breaks down, it can continue driving) is necessary. Though the cooling condition was disadvantageous specification, it was an important requirement for the product side and it was judged to be able to overcome by freely using the cooling technology.

As the technology to improve cooling ability, there are many technologies included, such as the liquid cooling technology, heat pipe technology, etc. NEC has developed these technologies through developing a supercomputer, but this time they are not adopted.

These technologies can keep away heat from a heat source, but a large size heat sink is essential in order to dissipate the heat to the atmosphere. In the blade server, air cooling usability exceeds a merit to adopt these technologies in the condition of a limited implementation volume, and necessity of hot plug.

And now, heat resistance value is used to express ability of cooling system. Heat resistance (°C/W) is calculated that the temperature difference of heat source and environment (°C) is divided by power consumption (W). Cooling ability of a heat sink has been calculated as the surface area of a heat sink by the wind velocity of the air physically (cf. Fig. 3)
An implementation volume is limited, and, as the larger size of a heat sink is needed, plural server crowds and cannot adopt a method to dissipate heat to body like the notebook-sized personal computer. NEC blade server adopts the following technology in order to overcome these problems.

1) High efficiency heat sinks adopt the crimp-fin technology. By this technology, large-size fin caulking can be fixed to a pedestal with high density. Accordingly, stable heat resistance is achieved.

2) Strong fans extend to three phases which overcome the wind pressure loss, and achieve cooling redundancy. There are fans in front-side (3x) and back-side (2x) of chassis, the total of 5x127mm in diameter, and a blade carries two high performance fans (each of which includes dual motors and fans). Furthermore, when heat load is low, revolution of fans slow down and reduce the acoustic noise.

3) The most suitable arrangement of parts is adopted. HDD which is sensitive by temperature is allocated in the windward side, and large-volume heat sink whose volume is accordance with cooling conditions is disposed. Chip set and other devices are placed leeward successively.

4) An opening area of the wind road bottleneck is enlarged. We changed a panel of accessory slot compatible with PCI-X and adopted bunch of I/O cable (USB, VGA, and COM) for ventilation. And we also established a notch in the Mid-Plane to reduce the wind pressure loss.

In the designing of chassis, we have repeated evaluation by a prototype and realized the most suitable part alignment and parameters.
4. CONCLUSION
As a result, NEC Express5800/BladeServer achieves stable cooling performance even if its one of fans is broken down (cf. Fig. 4). NEC Express5800/BladeServer which achieves high efficiency and high density plays an important part of a network system development.

Fig.4 Thermal integrations in fan malfunction.

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