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WHITE PAPER

Delivering Improved Energy Efficiency for the Datacenter

Sponsored by: NEC

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EXECUTIVE SUMMARY

In today's business climate, with growing global awareness of environmental issues and rising costs of energy, enterprises and vendors alike are responding by looking for new ways to build and use more energy-efficient products. The datacenter has emerged as a particular area of focus, as an explosion in the number of servers in the average datacenter, as well as in the density of those servers, has resulted in significant growth in power and cooling costs and carbon emissions. Little more than an afterthought as recently as a decade ago, power and cooling concerns have risen to the top of the list of IT managers' challenges.

NEC is responding by launching a new solution called REAL IT COOL. Part of NEC's broader vision of reducing carbon emissions by developing more environmentally sound products and solutions, REAL IT COOL is an end-to-end approach to managing and reducing energy requirements for the datacenter. REAL IT COOL consists of three primary elements:

- **Hardware.** The heart of REAL IT COOL is the ECO CENTER server, a high-density datacenter-class system designed with energy efficiency in mind.
- **Software.** SigmaSystemCenter provides a number of energy power and management features and, in conjunction with its built-in virtualization support, can help IT managers allocate workloads to maximize energy efficiency.
- **Services.** NEC's professional services include offerings to help IT managers assess, design, and manage more energy-efficient datacenters.

NEC is likely to face challenges with this new offering. Challenges include competitive pressures from both traditional IT vendors as they continue to market their own energy-efficient solutions and nontraditional vendors such as facilities management firms that have long-standing relationships with datacenter facilities managers. In addition, this is a new area for NEC, and the company will need to educate the market to increase awareness for these offerings.

Despite these challenges, the holistic approach taken by REAL IT COOL to improving energy efficiency solves a very real need in the market. IDC believes that this end-to-end power and cooling solution will resonate with enterprise IT managers, and IDC would expect a significant number of NEC's customers to begin evaluating and adopting this technology for their datacenters.

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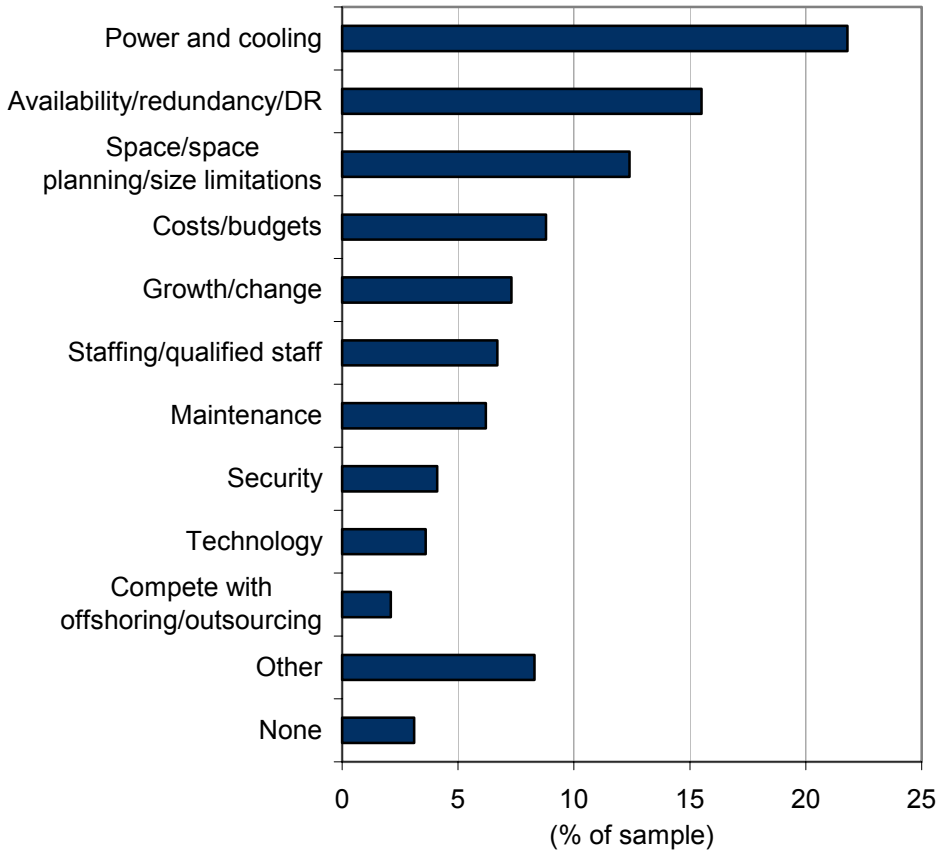
SITUATION OVERVIEW

For decades, corporations took their datacenter operations for granted, assuming that as their computing and application needs grew and as server acquisition costs fell, they could simply deploy new servers into their datacenter to handle the increased load. Recently, this dynamic has shifted as the proliferation of high-density computing in the datacenter has outpaced the datacenter's ability to support these systems, especially in terms of power and cooling. In fact, IDC surveys show that power and cooling has emerged as the number 1 challenge IT organizations face today (see Figure 1).

FIGURE 1

Datacenter Challenges

Q. What is the number 1 challenge that your datacenter faces today?



n = 197

Source: IDC, 2008

High-Density Computing Increases Power and Cooling Burden

Growth in business workloads has placed pressure on IT organizations to deploy greater compute capacity into their datacenters; unfortunately, datacenters are finite in their capacity, and it is expensive to build out new capacity. As a result, many organizations have deployed technologies such as blades, multicore architectures, and virtualization, resulting in datacenter compute infrastructures that have become very dense.

Most datacenters today are not designed to handle the densities that are already in place, let alone the increased densities they will likely face in the future. The average age of a datacenter in the United States is 12 years, which means that most datacenters were constructed at a time when power loads at the rack level were in the 2–5kW range. This was appropriate to support the mainframe and midrange technologies commonly deployed in those days, but with the introduction of blades and 1U servers, power densities in excess of 10kW per rack are now common, and 20–25kW per rack are not unheard of. This is placing stress on datacenters as they struggle to provide adequate power and cooling to keep up.

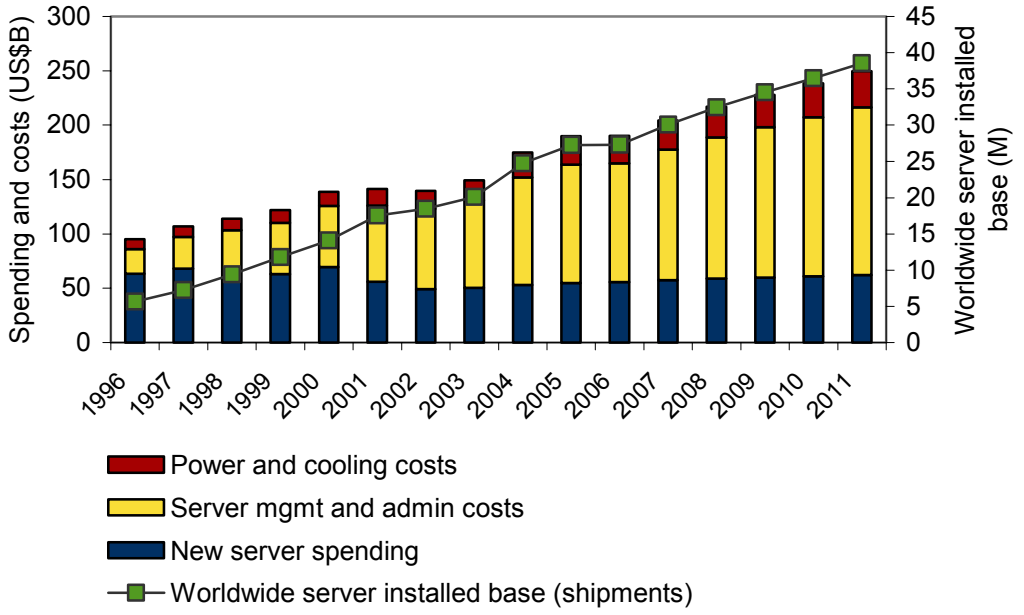
Server Proliferation Drives Power and Cooling Costs

Hand in hand with the shift to higher-density computing, the sheer number of servers supported by the datacenter has dramatically increased in recent years. IDC estimates that there were 5 million physical servers installed worldwide in 1996 and that this number has grown to more than 30 million today.

During this same time period, the average acquisition cost of these systems has dropped from approximately $35,000 to $5,000. This has allowed organizations to keep their overall new server spending relatively flat; however, the increase in the server installed base has driven up costs of management and administration, as well as power and cooling, to the point where these costs dwarf the costs of server acquisition (see Figure 2). In fact, IDC estimates that by 2011, for every dollar of new server spending, an additional $0.66 will be needed for power and cooling, a dramatic increase from the rate of $0.50 in 2005 and $0.21 in 2000.

FIGURE 2

Power and Cooling Forecast



Source: IDC, 2008

Implications for IT Organizations

With processing becoming more commoditized, power and cooling has emerged as one of today's key limiting factors to IT's ability to deliver the compute resources that enterprises require. This is in stark contrast to the situation only a few years ago when power and cooling was a relative afterthought for many companies.

Further, with energy prices at all-time highs, the expenses associated with power and cooling in the datacenter are rising sharply. This is forcing enterprises to increase focus on the design and capabilities of their datacenters. The ability to optimize power consumption, adequately cool the heat exhaust, and monitor the ongoing operations of the datacenter is vital to the ability of IT to successfully meet its service-level agreements to the organization.

IMPROVING ENERGY EFFICIENCY WITH NEC REAL IT COOL

NEC is committed to a vision of global environmental responsibility. Under the *NEC Environmental Management Vision 2010*, NEC is working to reduce CO_2 emissions — those caused by the use of NEC products at customer sites as well as those created through product production activities — through advanced, environmentally sound products and IT solutions.

A central component of this vision is the NEC REAL IT COOL project. Under REAL IT COOL, NEC aims to cut the power used by its customers' IT platforms by 50% and to realize a cumulative reduction in CO_2 emissions from IT devices used by its customers by over 900,000 tons by 2012.

The energy challenges within the datacenter are complex, and achieving these goals requires a holistic approach to increasing energy efficiency. REAL IT COOL addresses these challenges by providing an end-to-end solution to help enterprise IT organizations gain greater efficiency in their datacenter power and cooling. REAL IT COOL consists of:

- **Hardware.** REAL IT COOL starts with the ECO CENTER server, which was designed with energy efficiency in mind and consumes less than half the power of comparable previous-generation NEC servers.
- **Software.** SigmaSystemCenter provides the ability to track and manage power and cooling throughout the datacenter and, in conjunction with virtualization technologies, can assist IT managers in allocating server workloads to optimize energy efficiency.
- **Services.** NEC offers a range of professional services intended to help enterprises assess, design, and manage their datacenters in a more energy-efficient manner.

ECO CENTER Energy-Saving Server

The core product in REAL IT COOL is the ECO CENTER server. With the ECO CENTER, NEC has leveraged its expertise in mainframe computing technology to deliver a more energy-efficient, high-density server system in rack-optimized format designed for datacenter use. According to NEC, the ECO CENTER consumes up to 55% less power, occupies 50% less space, and is approximately 58% lighter than comparable previous-generation NEC servers. According to NEC, in the SPECpower_ssj2008, the benchmark by the Standard Performance Evaluation Corporation (SPEC) that evaluated the power-performance characteristics of one subset of server workloads — the performance of server-side Java — the ECO CENTER scored a 1,010 overall ssj_ops/watt.[1]

By focusing on energy efficiency with the ECO CENTER, NEC aims not only to help its customers achieve cost savings in power and cooling but also to help their datacenters achieve eco-friendly carbon-reduction targets. The ECO CENTER achieves these gains in efficiency through:

- Design for electrical power conservation
- High-density, low-weight design

[1] SPEC and SPECpower_ssj are trademarks of the Standard Performance Evaluation Corporation. A full explanation of the benchmark tests and results was published on **http://www.spec.org/power_ssj2008** on July 31, 2008.

Electrical Power Conservation

The ECO CENTER incorporates a number of design elements to reduce power consumption, starting with a power supply designed to operate at maximum efficiency at typical server load points. Servers typically have relatively low workloads, but previous-generation power supplies tend to be at their most efficient when run at higher capacities. This causes a mismatch in which power supplies are less efficient — i.e., waste more energy — when powering servers running the workloads found in most datacenter environments. In comparison, the ECO CENTER power supply was designed from the start to work at maximum efficiency for servers running typical datacenter workloads.

Energy-efficient features also include a server design intended to maximize cooling airflow. ECO CENTER components are strategically located to reduce airflow obstructions, with streamlined cabling, heat sinks, and DIMM slots. The goal is to maximize the cooling airflow through the server to better reduce the system's temperature and the amount of energy required to cool it.

Finally, the system also features a number of power conservation component technologies. Examples include Intel's power-saving low-voltage Quad Core Xeon Processors, power-saving chipsets, power-saving memory, and power supply units with 20% less energy dissipation than units found in previous-generation NEC systems.

High-Density, Low-Weight Design

The ECO CENTER comes in a dedicated housing designed to reduce the footprint required for enterprise datacenter deployments. It combines two servers into a single module and supports up to 32 modules in a single cabinet. So a full 64-server configuration can be supported in a single cabinet, compared with the two racks that would be required for a similar 64-server deployment of previous-generation NEC rackmounted servers.

In addition, the server module is composed of lightweight aluminum alloy material. According to NEC, a single-cabinet 64-server ECO CENTER configuration with these lighter-weight components would weigh 553kg, 58% less than the 1,300kg required for a two-rack deployment of 64 previous-generation NEC rackmounted servers. This high-density, low-weight design can help datacenters facing space constraints to maximize their compute power per square foot.

SigmaSystemCenter Software and Virtualization Support

Hardware efficiencies alone are not sufficient to provide a complete approach to minimize energy requirements. NEC complements the efficiencies of the ECO CENTER server with software solutions that incorporate power management capabilities. The core software offering is the SigmaSystemCenter, which provides integrated visualization of server metrics, power consumption, and temperature distribution of key components of the datacenter.

One way SigmaSystemCenter can enhance energy efficiencies is simply through power consumption control. It enables IT administrators to monitor and control the datacenter power consumption and thermal environment, including servers, chassis, server racks, and the datacenter as a whole. Administrators can set permissions and business priorities to enforce an upper power consumption limit for any given component, preventing the given component from going over capacity.

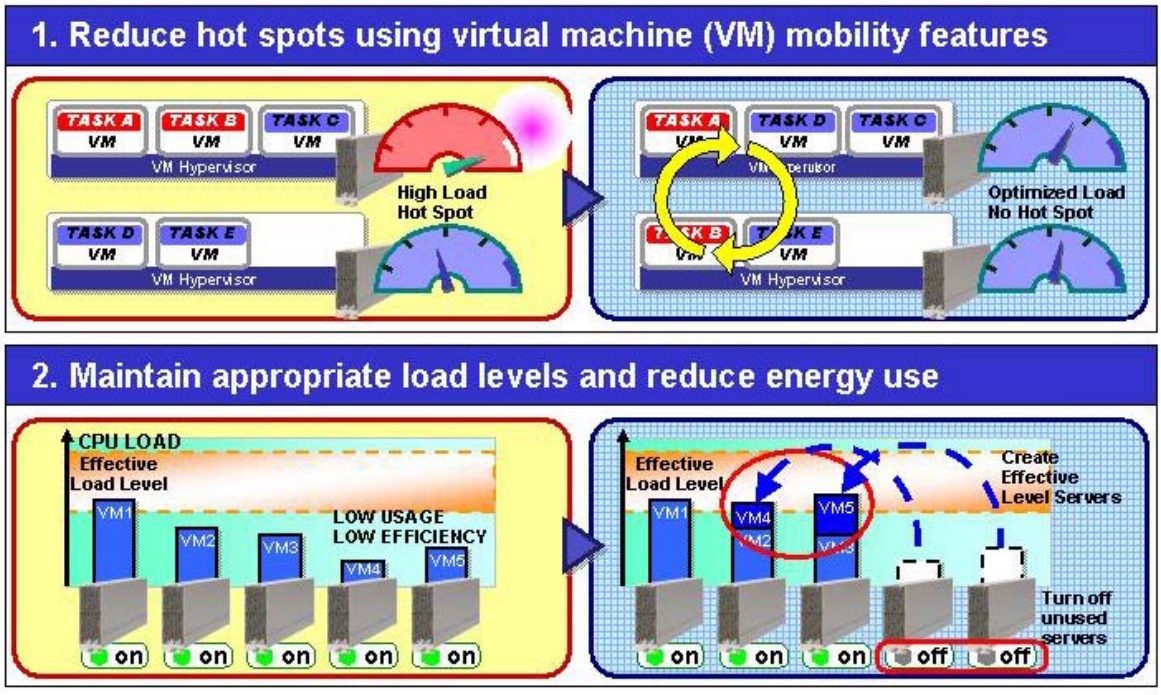
Power Conservation Through Virtualization

SigmaSystemCenter supports VMware ESX and Citrix XenServer virtualization technology. IT administrators can take advantage of these virtualization capabilities to realize additional power savings in two ways (see Figure 3):

- **Using virtual machine (VM) mobility to reduce hot spots.** Datacenter hot spots can be created when physical servers run at higher loads than their optimum efficiency level. Across an entire datacenter, there can be several servers running at high loads and thus creating hot spots, while other servers are underutilized. IT managers can use SigmaSystemCenter to identify these hot spots and then leverage virtualization to move workloads from high-load servers to less utilized servers.
- **Allocating VMs to maximize load efficiencies and turn off unused servers.** Another way virtualization can lead to greater energy efficiency is by enabling IT managers to consolidate loads on underutilized servers. This results in dual benefits: By increasing their workloads, servers can be run at peak energy efficiency, while the servers from which the workloads have been migrated can be shut off.

FIGURE 3

Two Approaches to Employing Virtualization to Save Energy



Source: NEC, 2008

NEC is planning to extend its support of virtualization by incorporating support for Microsoft Hyper-V in the future.

Energy-Saving Facility Service

The final part of NEC's energy-saving portfolio is its professional services offering. NEC provides three primary types of services to help enterprises reduce their datacenters' power consumption:

- **Planning and Assessment.** For new and/or existing sites, NEC can conduct thermal assessments and review customers' IT environments. With this service, NEC not only can perform surveys of the existing facility but also can conduct thermal simulations to identify potential hot spots and problem areas.
- **Design and Construction.** The next level of services consists of providing enterprises with a customized datacenter design tailored to meet the specific needs of their facilities and IT requirements.
- **Operational Monitoring.** To assist customers with their operations, NEC provides enterprises with around-the-clock remote monitoring to keep track of power consumption and savings and also provides incident backup.

CHALLENGES AND OPPORTUNITIES

Power and cooling has risen in importance to become a top priority for enterprise datacenter managers. Solutions such as REAL IT COOL address a genuine need, and IDC believes that REAL IT COOL's promise to provide reduced power consumption in a datacenter-ready, complete IT computing platform is likely to meet with a great deal of enthusiasm among NEC customers.

Nevertheless, for all the innovation and benefits associated with REAL IT COOL, barriers and challenges to adoption also exist. The first challenge is overcoming competitive forces. By providing solutions that address datacenter power and cooling concerns, NEC will find itself operating in the same arena as not only larger, established IT providers but also nontraditional vendors, including facilities vendors such as Liebert and APC. These vendors have long-standing relationships with both datacenter and facilities managers. Additionally, these vendors have ramped up their own power and cooling offerings to include more sophisticated power management tools and modular cooling units. While NEC's compute platforms designed to increase energy efficiency complement — rather than compete with — air conditioning and facilities management products, the question is where customers will look to solve their thermal concerns.

The second challenge is the need for NEC to demonstrate awareness for its power and cooling solutions in the market. This is NEC's first significant foray into this arena, and as such the company does not have an established track record in energy-efficient solutions. Despite the significant attention being paid to improving energy efficiency in the datacenter, this market is still evolving, and REAL IT COOL will likely face adoption issues as a viable solution in this space. To address this challenge, NEC must establish its reputation and educate clients on how REAL IT COOL effectively solves thermal and power concerns within datacenters, particularly for facilities managers who may be less familiar with NEC's offerings than their IT counterparts.

CONCLUSION

Over the past decade, enterprises have crammed more and more servers into their datacenters while increasing their datacenter compute density. This has placed a great burden on their power and cooling requirements, to the point that power and cooling has risen to the top of the list of IT managers' concerns.

NEC has recently released REAL IT COOL, an end-to-end approach to providing increased energy efficiency for the datacenter. With ECO CENTER energy-efficient servers; SigmaSystemCenter management software; and professional services to help enterprises assess, design, and manage energy efficient datacenters, NEC is providing a holistic approach to address the power and cooling requirements of today's enterprise datacenter. This increased efficiency should help NEC customers not only lower their costs for power and cooling but also achieve eco-friendly environmental goals.