CASE STUDY
Intel® Xeon® Processor E5 Family
Data Center Power Optimization using Intel® Node Manager and Intel® Data Center Manager

Dynamically Controlling Server Power Consumption and Reducing Data Center Peak Usage by 16 to 18 Percent

Securing Data Center Business Continuity during Power Outages

NTT DATA

NTT DATA CORPORATION (NTT DATA)

Headquarters: Toyosu Center Building, 3-3, Toyosu 3-chome, Koto-ku, Tokyo

Established: May 23, 1988

Capital: 142,520 million yen (as of March 31, 2011)

Business activities:
- System integration
- Network system service
- Other related businesses

http://www.nttdata.co.jp/

CHALLENGES
- Reduce peak power consumption in summer
- Extend data center operation time during power outage
- Secure business continuity and provide high-quality service at the data center

SOLUTIONS
- Intel® Xeon® processor E5 family
- Intel® Node Manager
- Intel® Data Center Manager

Increased Power Consumption in the Data Center and Control of Peak Power Consumption Required Due to the East Japan Great Disaster

NTT Data Corporation (NTT Data) has provided high-quality data center services for over 30 years. It has data centers not only in major domestic locations, but also overseas, mainly in Asia, supporting corporations supporting global businesses.

In recent years, data center power consumption has increased with installations of blade and high-density servers. Saving energy is becoming a common challenge for data center providers. Eastern Japan faced an even greater challenge in March of 2011 when it was hit by a magnitude 9.0 earthquake. Electrical power was in short supply because the nuclear power plants were shut down. Controlling peak power usage became more important than ever.

The Japanese government enforced control over the total volume of electrical power used in the summer of 2011. Even though the data center was not subjected to electrical power restrictions, large-volume consumers were requested to cut 15 percent from the previous year's power usage. This required them to take fundamental measures. Controlling electrical power usage is also important to keep costs and CO2 emissions down.

Normally when power is down, data centers can survive with a back-up power supply. For short periods of time, the uninterruptible power supply (UPS) and, for longer outages, power generators are used to supply power to data centers. However, the fuel supply for the generator may be disrupted during a widespread disaster, causing all servers to go down. Hiroshi Honjo, senior manager in charge of NTT Data's Global Business Alliance Group, Data Center Business Unit, Business Solutions Sector, said, "NTT Data takes care of mission-critical systems for major clients that make up the core of the Japanese economy, such as central government offices, financial institutions, and large corporations. Securing the quality and reliability of the data center is one of the most important challenges, and having a stable supply of electrical power is a mission to be prioritized."

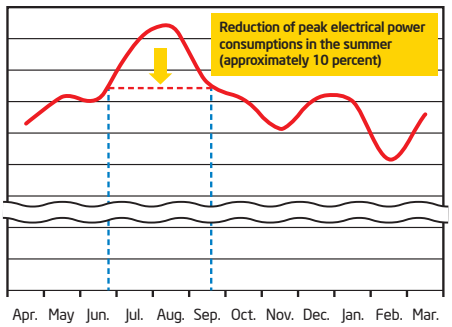

Figure 1. Reducing 10 percent of the peak electrical power consumption in the summer (the season when electrical power consumption is highest)

Intel® Node Manager Equipped with Intel® Xeon® Processor E5 Family Streamlines the Electrical Power Consumption of Servers

"For the data center business of NTT Data, which is taking care of mission-critical systems for central government offices and financial institutions, Intel® Node Manager and Intel® Data Center Manager are contributing to the securing of business continuity and also provide new added values."

– Hiroshi Honjo
Senior Manager
Business Solutions Sector
Data Center Business Unit
Global Business Alliance Group
NTT Data Corporation

After a disaster, more users rely on the data center services provided by NTT Data. They expect a high quality of management. To meet these expectations, NTT Data performed two tests to reduce percent peak electrical power consumptions in the summer by approximately 10 percent (Figure 1) and to extend operating time of the servers during power outages to enhance data centers' electrical power management function.

Electrical Power Consumption is Automatically Controlled with the Power Capping Function of Intel Node Manager and Intel Data Center Manager

In general, there are two approaches to saving energy at data centers. The first is to control the electrical power consumption of servers. The second is to control power consumption from the facility side, such as air conditioning. NTT Data targeted reducing the electrical power consumption of servers, focusing on the power - control function of Intel Node Manager, which is installed as a standard feature in many servers based on the Intel ® Xeon® processor E5 family. Intel Node Manager has a power capping function that can set a limit on electrical power consumption, allowing it to be controlled. With this in mind, NTT Data verified the functions of the Intel Node Manager and operability of the tools using servers equipped with the Intel Xeon processor E5 family.

Honjo explained the reason for selecting Intel as a collaborator: "As for the business of us handling various server products, we cannot use the functions that depend on the servers of vendors. Therefore, Intel was the perfect choice as a testing collaborator, since many of the servers at our data centers are equipped with Intel processors and common functions of the processor can be used."

The testing environment was developed inside an NTT Data center. Five servers equipped with Intel Xeon processor E5 family were installed (with one set up as a secondary server), and electrical power consumption and temperature changes were measured when 20 virtual servers for each server (a total of 80 virtual servers) were running.

The testing took approximately two and half months, from November 2011 to January 2012, starting with the development of the environment to the actual measurements.

A management console using Intel® Data Center Manager (Intel® DCM) middleware was used to aggregate the information from the five servers and carry out the power capping policies across the five servers. Intel DCM supports the notion of server groups and presents a Web services interface, relieving system integrators from having to code node-level IPMI calls required by Intel Node Manager.

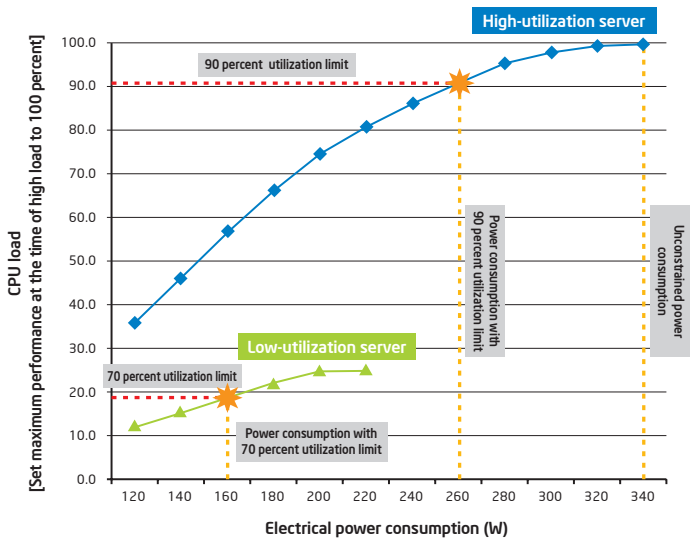

Figure 2. Maximum set to 90 percent of maximum performance for high-load server and 70 percent of maximum performance for low-load server

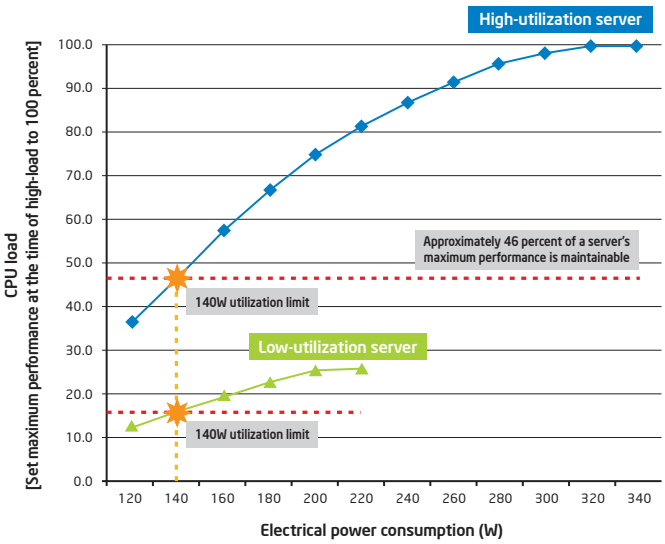

Figure 3. Set maximum server electrical power consumption to 140 W

Test 1: Reducing peak electrical power

When the maximum performance at the time of high load is set to 100 percent, the maximum value of electrical power is set in the range where it will not affect the performance of the server as much, and electrical power consumption is controlled. The maximum value was set to 90 percent of the maximum performance (260 W per server) for servers with high loads, such as those that use complex information processing systems. The maximum value was set to 70 percent of the maximum performance (160 W per server) for servers with low loads, such as those that act as file servers (Figure 2).

Test 2: Extending operating time during power outages

The electrical power to maintain the minimal server performance was set at 140 W per server, and the electrical power consumption was controlled with Intel Node Manager (Figure 3). Approximately 46 percent of the maximum performance of servers can be maintained even when the maximum value is set to 140 W.

16 to 18 Percent of Electrical Power Reduction Achieved at Data Center

Considering realistic usage at the data center, simulation was performed assuming 100 server racks with seven servers operating in each rack. The energy elements used in data centers can be divided into hardware (mainly the servers), and facilities (mainly air conditioning and lighting). In this simulation, it was assumed that the data center has fairly high efficiency, and 1.6 was set as the summer value for the indicator to show power usage effectiveness (PUE).

Test 1 results: 20 percent reduction in the electrical power consumption of servers with high loads

During high loads, when the electrical power is controlled, with 90 percent set as the maximum performance of the server, the electrical power consumption is reduced by 23.5 percent for all the servers. Furthermore, when the PUE is set to 1.6, approximately 18 percent of electrical power can be reduced for the entire data center (Figure 4).

ABOUT INTEL NODE MANAGER

Intel Node Manager and Intel Data Center Manager have been available with the Intel ® server chipset, the platform since the Intel Xeon processor 5500 series. The technology enables temperature and power monitoring and carries out policy-based power management. Main capabilities:

- Real-time monitoring of server power measured at 10% ± tolerance within the power consumption of the server.
- Power capping of the server (setting the upper limit of power consumption) to maximize performance while keeping power consumption within the power of the target server.
- Alert threshold power Intel Node Manager monitors server power against a set target power and issues an alert if power limit is exceeded.

ABOUT INTEL® DATA CENTER MANAGER

Intel® Data Center Manager (Intel® DCM) provides accurate, real time power and thermal monitoring and management for individual servers, group of servers, racks and IT equipment such as PDUs in the data center. It's a capability that is useful for both IT and facility administrators, which allows them to work jointly to reduce the Energy footprint.

PUE is an indicator defined by Green Grid, a global consortium working to improve power efficiency in the data center system. PUE is a metric for the efficiency of electricity use, defined as:

$$\text{PUE} = \frac{\text{Total power dissipation in a target facility}}{\text{total power consumption for the IT equipment}}$$

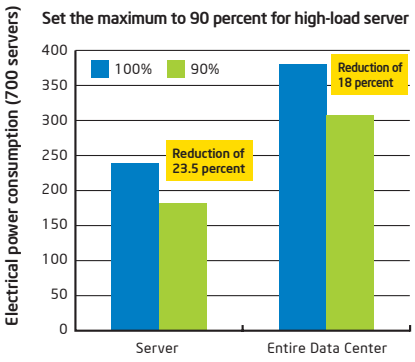

Figure 4. 23.5 percent electrical power reduction at all servers, 18 percent reduction at the data center

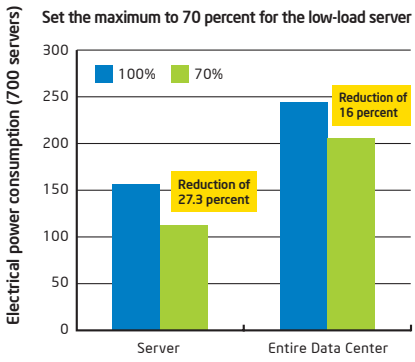

Figure 5. 27.3 percent electrical power reduction at all servers, 16 percent reduction at the data center

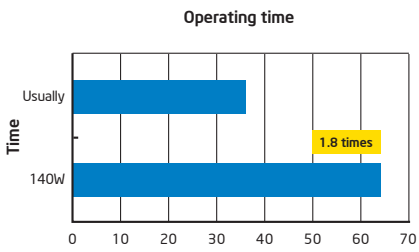

Figure 6. Realized operation of 64 hours, which is approximately 1.8 times the time when the standard operation time for the fuel tank is assumed to be 36 hours

During low loads, when the electrical power is controlled with 70 percent set as the maximum performance, the electrical power consumption can be reduced by 27.3 percent for all the servers, and approximately 16 percent for the entire data center (Figure 5).

Test 2 results: Approximately 1.8 times longer operation time achieved

By maintaining the total electrical power consumption at 140 W and setting the PUE to 1.6, a 44.4 percent electrical power consumption reduction can be expected at the data center. When the standard operation time for the fuel tank for the power generator is assumed to be 36 hours, it is possible to operate for 64 hours, which is approximately 1.8 times longer than normal (Figure 6).

Increased Business Continuity of the Data Center and Providing New Added Value

From the results of the tests, NTT Data found it could reduce electrical power consumption in the data center by more than the assumed amount using the Intel Xeon processor E5 family, Intel Node Manager and Intel Data Center Manager. This result is connected directly to the business continuity of the data center business and allows NTT Data to provide reliable and stable service to clients entrusting their mission-critical system to the data center. Honjo said, "In addition to the essential robustness of the data center, it is now possible to provide a new added value - that the power supply of servers never needs to be shut down," about the business impact brought by Intel's solution.

It is advisable to dynamically automate the monitoring and management of electrical power of the entire data center by linking the electrical power management function of the server with the electrical management function of the facility, such as air conditioning.

Furthermore, NTT Data is developing a new business model using Intel Node Manager, looking for new service deployment to support the greening of IT at clients by expanding the concept of service-level assurance (SLA) to include electrical power consumption, ensuring that it will not exceed a certain level of electrical power.

With the tests it performed, NTT Data confirmed that Intel Node Manager can contribute significantly to the overall business of NTT Data. Honjo said, "The electrical power limitation function is also valid for the cloud business, providing stable service at a low cost. There is also a possibility for the power supply management function to work effectively in Asian regions where power outages are frequent, or in Europe where the environmental requirements are stricter than in Japan."

After the 2011 disaster, Japan is facing realistic problems relating to the operation and business continuity of data centers. While coping with these problems, important knowledge was gained that can be shared with the world. NTT Data plans to contribute to the business world by disclosing these experiences and test results through activities of the Open Data Center Alliance (ODCA). Intel technologies will continue to contribute to the development of NTT Data and its expanding global business.

SUMMARY OF TEST RESULTS

- It is possible to reduce 18 percent of the peak electrical power usage in the data center by reducing the performance of high-load servers to 90 percent.
- It is possible to reduce 16 percent of the peak electrical power usage in the data center by reducing the performance of low-load servers to 70 percent.
- It is possible to extend the operating time of the data center during a power outage by approximately 1.8 times by maintaining the total electrical power of a server to 140 W.

For details about the Intel Xeon processor, visit www.intel.com/xeon

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