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Hitachi, Ltd.

Air-conditioning power conservation through real-time collaborative control between IT equipment and air conditioners for eco-friendly data centers

18-34% air-conditioning power reduction confirmed in small-scale experimental setup using two air conditioners

Tokyo, 8th September 2010 --- Hitachi, Ltd. (NYSE : HIT/TSE : 6501) today announced the development of technology to reduce air-conditioning power in data centers through real-time collaborative control between IT equipment and air conditioners. The technology developed includes a system that first, prerecords analytical results (conditions of airflow and temperature in the data center) in table form into a database. This drastically reduces the time spent calculating the optimum conditions for data center operation to achieve real-time collaborative control. When this system was applied to a small-scale experimental environment using two air conditioners, compared to a similar environment where the air supply temperature is fixed, an 18-34% reduction in air-conditioning power was confirmed.

In recent years, businesses employing data centers for services such as cloud computing have been increasing. At the same time, from a global environmental perspective, the large amount of power required by data centers is becoming an issue. Against such a backdrop, the Hitachi Group announced a target to reduce power consumption in data centers by a maximum of 50% of the fiscal year 2007 baseline by fiscal year 2012, as part of the eco-friendly data center project, and been promoting such efforts.

To reduce power consumption in data centers, it is necessary not only to reduce power consumption in IT equipment, but also that of air-conditioners and uninterruptible power sources (UPS) which consume a large proportion of the power. With that goal in mind, Hitachi developed real-time power control technology for data centers using collaborative operation management between IT equipment and air-conditioning, and evaluated it benefit. The technology developed controls the load assignment to IT equipment as well as the number of air conditioners in operation and their air supply temperature in real time. Details of the system developed are as described below.

Previously, Hitachi pursued development using a high-speed simulator enabling 3D thermo-hydrodynamic analysis[*1] to predict the temperature of arbitrary locations within the data center from time to time, and control IT equipment and air-conditioning. In order to obtain the optimal control

condition using 3D thermo-hydrodynamic simulation, however, a multitude of simulations on various conditions with different numbers of air-conditioners and air-supply temperature is necessary, requiring much time. As a result, until now, power-saving control was limited to the verification of power-saving settings based on actual data using high-speed simulation. In the current development, by conducting a linear approximation[*2] of heat flow within the data center, the temperature sensitivity[*3] which is the relationship between the temperatures of the air flowing in and out of each IT equipment and the supply and exhaust air temperature of air-conditioners, was tabulated using 3D thermo-hydrodynamic simulation. Thus, by preparing a temperature sensitivity table, quick analysis under actual operating conditions became possible.

By using this temperature sensitivity table, and conducting an optimized calculation to minimize the air-conditioning power on expected temperature rise of IT equipment based on previous operational history, real-time control of the number of operating air conditioners and their air supply temperature to maintain air-conditioning performance at IT equipment, was enabled. Further, by defining air-conditioning efficiency[*4] which can be deduced from this table as the power fluctuation in air-conditioners as a result of power fluctuations in IT equipment, work load allocation can be prioritized to IT equipment with high air-conditioning efficiency to optimize the air-conditioning efficiency of the entire system and thus, reduce the total power consumption of the data center including the power consumption of IT equipment and air conditioners.

When the effectiveness of the newly developed collaborative control technology in reducing air-conditioning power consumption was tested in a small-scale pilot test using two air-conditioners, compared to a conventional two air-conditioner environment with fixed air-supply temperature, a reduction 18% was achieved with collaborative control of two air-conditioners, and 34% with collaborative control of one air conditioner.

Although the verification was done using a small-scale pilot system, the technology developed can easily be applied to the optimal control of floors or zones in a data center, and confirms the basic power-saving benefits of the IT equipment collaborative control system being developed to achieve the target of the eco-friendly data center project. The next steps will be to conduct pilot tests in Hitachi's data centers to verify power-saving benefits of the technology in an operating data center.

These results were presented at the 9th Forum on Information Technology 2010, which was held from 7th to 9th September 2010 at the Ito Campus of the Kyushu University, Fukuoka, Japan.

Notes:

*1: Three-dimensional thermo-hydrodynamic analysis: a method of analysis which divides a three-dimensional structure model into a lattice and then calculates the thermo-hydrodynamic equation at each lattice point to obtain the airflow and temperature.

*2: Linear approximation: approximation of any function by a simple linear function.. In this case, as the air flow in the data center is mainly the the air flow from the air conditioners, natural convection is disregarded and the temperature of the airflowing in and out of the IT equipment and the temperature of the return air of the air conditioner can be represented as a coefficient matrix of a linear function of the temperature increase of IT equipment and the air supply of the air conditioner.

*3: Temperature sensitivity: The return air temperature and the temperature increase in the temperature of the air flowing into IT equipment when the exhaust temperature of an arbitrary IT equipment and the supply air temperature of the air-conditioner increased by 1°C.

*4: Air conditioning efficiency: The amount of increase in air-conditioning power consumption as a result of a 1kW increase in power consumption in IT equipment. The lower the figure, the higher the air-conditioning efficiency is considered to be.

About Hitachi, Ltd.

Hitachi, Ltd., (NYSE: HIT / TSE: 6501), headquartered in Tokyo, Japan, is a leading global electronics company with approximately 360,000 employees worldwide. Fiscal 2009 (ended March 31, 2010) consolidated revenues totaled 8,968 billion yen ($96.4 billion). Hitachi will focus more than ever on the Social Innovation Business, which includes information and telecommunication systems, power systems, environmental, industrial and transportation systems, and social and urban systems, as well as the sophisticated materials and key devices that support them. For more information on Hitachi, please visit the company's website at http://www.hitachi.com.

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