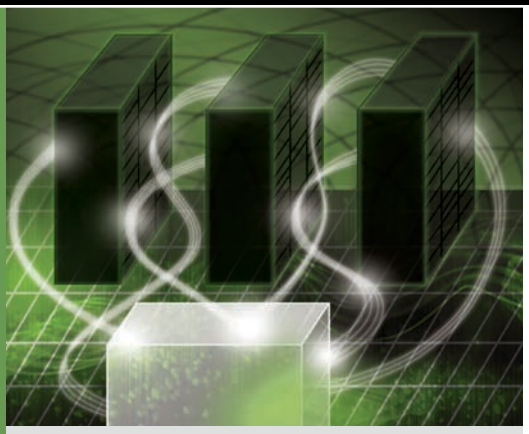

A SYSTEMS-LEVEL APPROACH TO EFFICIENT DATA CENTER DESIGN

By Fred Stack

The increasing need for high-performance, rack-dense servers has strained the limits of many data center cooling systems. Dell-Liebert Energy Smart Solutions can help organizations overcome these limits, enabling them to increase performance while maintaining existing levels of energy use or to provide sufficient cooling for a maximum-performance infrastructure.

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Rising demand for computing capacity and constraints on power and cooling are forcing many organizations to consider building new IT facilities much earlier than they had anticipated. For example, according to a survey by the Data Center Users' Group, 96 percent of data centers are expected to reach capacity by 2011, even though many of those facilities were built in the last 10 years.[1]

Physical space alone is typically not the problem. As server form factors continue to shrink while processing power grows, many facilities have ample physical space for additional servers. What they lack is the power and cooling to support additional devices. Rapidly increasing rack densities have forced data center managers to leave open space in racks or spread racks out across the room to help ensure proper cooling—an inefficient use of space and cooling systems that can limit data center growth.

Dell-Liebert Energy Smart Solutions are designed to help enterprises overcome these limitations. By taking a systems-level approach to data center design that combines efficient Dell™ PowerEdge™ Energy Smart servers with Liebert DS™ and Liebert XD™ precision cooling systems from Emerson Network Power, these solutions enable IT managers to provide sufficient cooling for a maximum-performance infrastructure or to increase overall performance without requiring additional energy use.

DEPLOYING EFFICIENT INFRASTRUCTURE TECHNOLOGIES

Designing an efficient infrastructure requires coordinating technologies at the server level and the room level. At the server level, efficient servers incorporate advanced processor, memory, power, and thermal design technology to help increase performance while reducing power consumption. Complementing these servers with an efficient infrastructure helps enable organizations to both increase data center rack processing power and reduce cooling-related energy costs.

At the room level, Emerson Network Power provides variable-capacity cooling systems, such as the Liebert DS precision cooling system, with Copeland Digital Scroll™ compressors and variable-speed motors that enable highly efficient operation at partial loads. The Liebert DS also employs an intelligent control system that can facilitate coordination between multiple cooling units in a room.

[1] "Emerson Network Power Presents Industry Survey Results That Project 96 Percent of Today's Data Centers Will Run Out of Capacity by 2011," by Emerson Network Power, November 16, 2006, www.liebert.com/information_pages/NewsRelease.aspx?id=2386.

> **"By taking a systems-level approach to data center design, these solutions enable IT managers to provide sufficient cooling for a maximum-performance infrastructure or to increase overall performance without requiring additional energy use."**

Computer room air-conditioning units can typically provide efficient environmental control for rack densities of up to 5 kW per rack. When using densities higher than that level, organizations should add supplemental cooling systems close to the heat source to assist with heat removal. (The room cooling systems are still necessary to control humidity and air quality and assist in balancing temperatures across the room.) By reducing the distance cold air must travel across the room, this approach helps reduce the energy required to move it.

For example, the flexible and efficient Liebert XD precision supplemental cooling system from Emerson Network Power uses a pumped refrigerant infrastructure to support cooling modules placed directly above or alongside high-density racks, supplementing the air coming up through the floor and helping eliminate cooling-related density or capacity limitations. Compared with traditional water-based room cooling systems, Liebert XD systems are designed to reduce energy requirements when operating at both full and half load.

TESTING DELL-LIEBERT ENERGY SMART SOLUTIONS

Advances in server and cooling system technology can have a major impact on data center performance and efficiency when server and infrastructure manufacturers work together to take a true systems-level approach to data center design. This philosophy has led to the creation of Dell-Liebert Energy Smart Solutions.

To demonstrate how these solutions can help address the challenges that IT management face today, in summer 2007 Dell and Emerson Network Power experts simulated a model data center using a baseline environment of 50 racks of Dell PowerEdge 1850 servers, each with two dual-core Intel® Xeon® 7030 processors at 2.8 GHz, 4 GB of double data rate 2 (DDR2) memory, and two 36 GB, 15,000 rpm hard drives. Using the SPECjbb2005 benchmark to measure performance, the test team determined that each server produced a benchmark rating of 46,360 business operations per second (bops) while using 405 W of power, for a total power consumption of 243 kW. The test environment assumed a raised-floor cooling capacity of approximately 5 kW per rack, which limited each rack to 12 servers, for a total of 600 servers in the data center. Cooling was provided by three Liebert Deluxe FH740C computer room air-conditioning units, which used a total of 86.6 kW of power. Overall, this baseline environment had a total benchmark performance rating of 27,816,000 bops and a total power consumption for the servers and cooling units of 329.6 kW, with a total facility power consumption of 471 kW.

Next, the test team upgraded the environment to increase computing capacity without increasing overall power consumption by replacing the 600 PowerEdge 1850 servers with 1,148 PowerEdge Energy Smart 1950 servers, each with two dual-core Intel Xeon 5148LV processors at 2.33 GHz, 4 GB of DDR2 memory, and two 73 GB, 10,000 rpm hard drives (see Figure 1). They also reconfigured the data center from 50 racks of 12 servers each to 28 racks of 41 servers each. Each PowerEdge 1950 produced a SPECjbb2005 rating of 84,312 bops while using 234 W of power, for a total power consumption of 268.6 kW. In addition to upgrading the servers, the test team replaced the three fixed-capacity Liebert Deluxe FH740C units with two variable-capacity Liebert Deluxe FH740C units and one Liebert XD supplemental cooling system using Liebert XDV units on

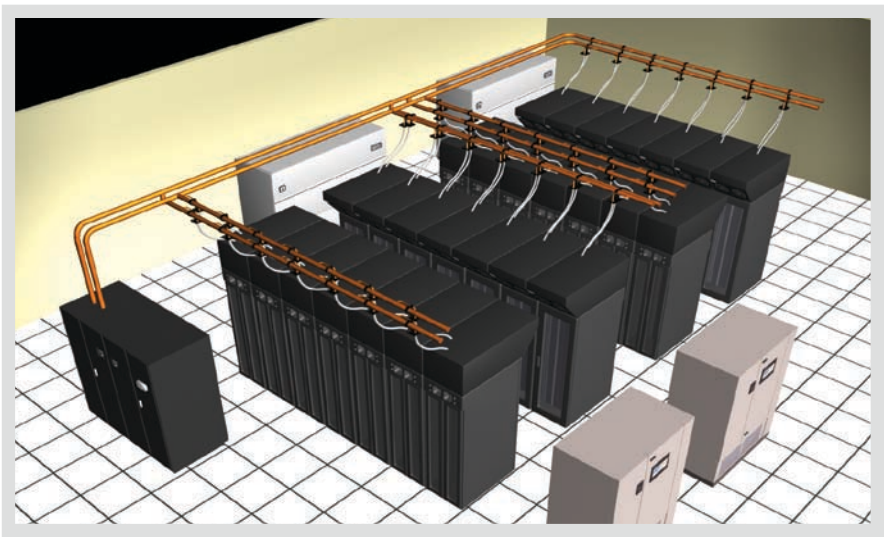

Figure 1. *Dell PowerEdge Energy Smart 1950 servers and energy-efficient Liebert cooling systems provided increased performance without increased power consumption*

top of the racks to support the increased rack density, a setup that used a total of 56.2 kW of power for cooling. Overall, this environment had a total benchmark performance rating of 96,790,176 bops and a total power consumption for the servers and cooling units of 324.6 kW, with a total facility power consumption of 464 kW—a 350 percent increase in performance over the baseline environment while using a comparable amount of power.

The test team next upgraded the environment further to help maximize processing performance by filling all of the available space in the 50 racks, replacing the 600 PowerEdge 1850 servers with 2,100 PowerEdge Energy Smart 1950 servers, for a total power consumption of 491.4 kW (see Figure 2). They also upgraded the cooling systems to handle the increased heat load, replacing the three fixed-capacity Liebert Deluxe FH740C units with two variable-capacity Liebert Deluxe FH740C precision cooling systems and two Liebert XD supplemental cooling systems using Liebert XDV units on top of the racks, a setup that used a total of 75.2 kW of power for cooling. Overall, this environment had a total benchmark performance of 177,055,200 bops and a total power consumption for the servers and cooling units of 566.6 kW, with a total facility power consumption of 852 kW—an 81 percent increase in power consumption, but a 637 percent increase in performance over the baseline environment.

"IT managers do not need to wait for complicated control schemes—which may take years to fully develop—to achieve significant increases in efficiency and performance. By taking a systems-level approach to data center design and combining multiple technologies available today, Dell-Liebert Energy Smart Solutions can help increase both efficiency and performance."

DESIGNING FOR HIGH EFFICIENCY AND PERFORMANCE

IT managers do not need to wait for complicated control schemes—which may take years to fully develop—to achieve significant increases in efficiency and performance. By taking a systems-level approach to data center design and combining multiple technologies available today, Dell-Liebert Energy Smart Solutions can help increase both efficiency and performance and help remove limits to continued data center growth.

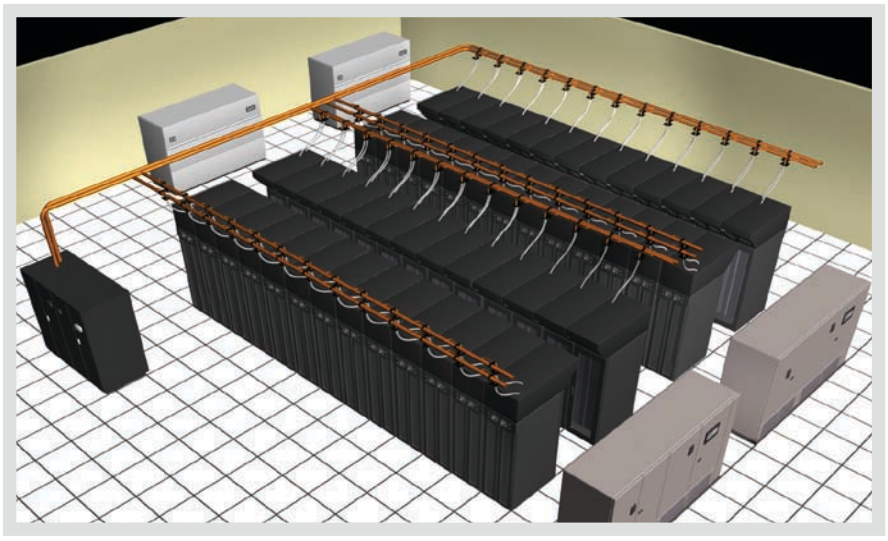

Figure 2. *Liebert cooling systems help remove constraints on rack utilization for maximum data center performance*

Fred Stack is vice president of marketing for Liebert Precision Cooling, part of Emerson Network Power. He is responsible for new product development road maps that reflect evolving market demands and incorporate new technology, and that serve as the foundation for development of new products and application engineering tools. He has previously worked in technical marketing and sales for Rockwell International and several divisions of General Electric. Fred has a B.S. in mechanical engineering from Tulane University and an M.B.A. from Southern Methodist University.

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