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# Keep Your Cool

## If the cooling system in your data center racks and rooms isn't adequate, your IT gear can melt down. Here are some ways you can reduce and remove excess heat.

Today's thinner blade servers, more powerful N-Way servers and higher-capacity disk drives are "densifying" the racks in companies' computer rooms and data centers, packing more power into smaller spaces, and letting IT managers consolidate older, larger boxes into a fraction of their original space.

"Three to five years ago, an average server was 5U, and you would have three to five servers in a rack, plus other equipment, averaging a power consumption of 2 to 3 kilowatts [kW] per rack," says Kevin Nusky, product line manager for InfraStruXure, APC's fully integrated power, cooling and environmental management system. Today, with 1U and 2U servers available, "You can fit several dozen in a rack or blade chassis, for power densities of up to 30kW per rack."

That's good news for companies looking to increase their computing power and storage capacity without expanding or replacing their IT facilities. But it's bad news — or at minimum, a challenge — for those faced with keeping equipment cool enough to stay operational while keeping the power and space budget for cooling under control.

"Companies need to be prepared to provide cooling for more heat, and to deal with 'hot spots' — areas where heat builds up to the point where components may be damaged, or even cause equipment to crash," says Nusky. New server designs are projected to increase data center power consumption up to 300 watts per square foot, according to power and cooling vendor Liebert Corporation.

"When all the disks start spinning or a server's load goes up, you can get a heat rise of eight to 30 degrees Celsius — 14 to 50 degrees Fahrenheit — in five to 20 seconds," says APC's Nusky. "And if you lose cooling, it impacts your equipment in 30 seconds."

Cooling costs money, of course. The cost of electricity was an average of 20 percent higher in 2005 than 2004, according to IDC, rising 40 percent or more in some areas in the United States.

"The management of heat in the data center is a chain, starting with the chips, moving through the board, enclosure and rack, and ending with the data center as a whole," says Richard Fichera, an analyst in Forrester's Computing Infrastructures research group, in his March 2006 report

"Power and Cooling Heat Up the Data Center." "At each step, the basic challenge is to keep that layer of the infrastructure operating at a temperature that is within its limits and to remove the excess heat to an external and cooler environment."

## Beat the Heat

Cooling solutions fall into four main categories, according to Nusky: a building's own comfort cooling, usually vents in a room; a fan solution, which gets heat out of the room into the building's solution; spot cooling, using the building's system to take heat from the room; and a full-blown mechanical solution, usually a dedicated air conditioner.

A fan solution is the most desirable, says Nusky, as it costs the least to buy, install and maintain. But a fan solution isn't always an option, or sufficient. Wiring closets now have bigger switches, for example. "In this kind of space, you need cooling solutions that aren't always mechanically oriented — you don't have room to put them," he adds.

> "Users can take definite steps with today's technologies to minimize their data center heating and cooling costs while waiting for new solutions."

Overhead cooling or units in the corner of the room might be an option, depending on the space available. But air that's cold in the room's corners or ceiling may not sustain its temperature when it mixes with the remaining room air and is blown into the hot zone, or even reach hot zones quickly enough. Raised-floor cooling assumes you have a raised floor, and that this space isn't too jammed with power and network cabling to allow enough airflow.

All these approaches have another limitation, Nusky points out. With IT changes and refreshes every few years, the location of loads keeps moving, which means that last year's cooling placement may not be directed at today's or tomorrow's hot spots.

"You can feel microclimates as you walk through a data center," says Nusky. "I see a lot of spot fans and cooling in data centers to take care of these hot spots, trying to blow the heat away, and I've seen open doors in data centers to get a chimney effect."

According to Steve Madara, vice president and general manager, Environmental Business Unit, Emerson Network Power at Liebert, "Power packed into dense enclosures creates hot zones that conventional precision cooling can't touch."

One increasingly popular approach to bringing cooling where it's needed and applying it more efficiently is the "room within a room" solution — a rack that incorporates cooling equipment along with server/telecom gear, cabling and power.

Power/enclosure vendors including APC and Liebert, as well as such server vendors as HP and IBM, have been extending their rack solutions over the past year or so to incorporate cooling systems consisting of fans and ducting to improve air circulation and efficiency. APC, Liebert and others also offer products that pump heat out of the computer room, if the existing AC and ventilation are inadequate.

APC's modular InfraStruXure equipment applies cooling in racks, with cooling ducts in the rows with your computing, storage and network gear. "This provides more efficient distribution of air, potentially reducing your power costs by anywhere from 25 to 50 percent," according to APC's Nusky. "Half-rack cooling systems that get moved into the row increase your efficiency, because you're scavenging air where it's produced, in the 'hot' aisle, instead of the legacy approach of forcing air to mix."

Rack-oriented solutions from APC, Liebert and others include airflow management within the rack, as well as ways to remove the heat from the rack. APC's modular Rack Air Containment System (RACS), for example, removes exhaust so that warm exhaust doesn't work its way into the cooling environment. APC, Chatsworth Products Inc. and Liebert also offer water- or other refrigerant-based components to move heat out of the room.

For extremely higher densities, "extreme" water- or refrigerant-based solutions that cool at the rack level can cool up to 60kW a rack — more than enough for a rack full of blade servers, says Liebert's Madara.

HP's Modular Computer System provides water-based cooling for HP racks, attaching to the side of a rack and providing a sealed chamber of cooled air, which connects to an external chilled-water system. An upcoming version, due in early 2007, will be able to chill the air of an entire row of racks, according to HP. IBM's Cool Blue eServer Rear Door Heat eXchanger can reduce the load on many sites' air conditioning units, lower energy costs and let IT fully populate individual racks. Cool Blue uses the existing chilled water supply of many data centers' air conditioning systems.

Where more cooling is needed, supplemental cooling like Liebert's XDV and XDO systems is another option. The XDV system, designed for data centers without much floor space, mounts on top of a server rack and uses a liquid coolant that vaporizes into a gas within the cooling module.

And don't consider this investment as a necessary evil, says Liebert's Madara. "Typically, the equipment where you bring high-density cooling is more expensive than traditional cooling gear, but with the energy savings, return on investment [ROI] is six to 18 months, depending on how valuable your floor space is."

## Plan Ahead

Over the next several years, servers, storage and power gear will include lower-power and power-conserving options, as well as designs for better cooling. When you're shopping for new gear, ask about lower-power options. In the meantime, says Forrester's Fichera, "Users can take definite steps with today's technologies to minimize their data center heating and cooling costs while waiting for new solutions."

His advice: "Optimize your overall data center architecture and layout, implement spot cooling for problem racks and problem sections, and prioritize heating and cooling issues when selecting new systems and new systems management tools." In tackling these issues, says Fichera, management factors to consider include airflow, local hot spots and server load.

You should also start by checking your current systems. In their article, "Changing Cooling Requirements Leave Many Data Centers at Risk," W. Pitt Turner IV and Edward C. Koplin from ComputerSite Engineering, Inc. (CSE) cite a number of common problems, such as dirty or blocked coils choking airflow, reversed supply and return piping, and system capacity unintentionally restricted by partially closed valves. "Diagnosing and then correcting deficiencies via a midlife 'tune-up' can generate major savings [which can fund needed modifications] and significant performance improvements."

Another good starting point is a power audit. "You need to understand what your rack loads are," says Forrester's Fichera, who advises taking live readings, "as the data listed on gear is often inaccurate." Misunderstanding or miscalculating thermal requirements often leads to overbuilding cooling and power, translating to hundreds of thousands of dollars of unnecessary power supplies and computer room air conditioning, as well as computer rooms and data centers that are cooler than necessary.

Look for other places where you can reduce electric consumption; for example, do you have more uninterruptible power supply (UPS) capacity than you need? If you currently use single-phase power, look into three-phase, which is more efficient. If your servers include power management features, like HP's Power Regulator for ProLiant, see where you can turn processor speeds down. Server virtualization can also improve efficiency, notes Forrester's Fichera, as an idle x86 server consumes 30 to 40 percent of maximum power. Consolidating will improve overall utilization and efficiency.

It's equally important to identify what your coming requirements may be, so you can start strategizing. And, advises, Jeff Otchis, marketing manager, rack and power systems, HP, "Ensure that the IT manager is talking with the facilities manager."