HVAC and Other Environmental Controls

The control and maintenance of heating, ventilation and air conditioning (HVAC), as well as relative humidity (RH), are essential in the data center. Computer hardware requires a balanced and appropriate environment for continuous system operation. Temperatures and relative humidity levels outside of the specified ranges, or extreme swings in conditions, can lead to unreliable components or system failures. Control of these environmental factors also has an effect on the control of electrostatic discharge and corrosion of system components.

Over the past 20 years, there has been a geometric decrease in floor space requirements for the same computing/storage capacity. The trend is to greater performance in less physical space. At the same time, the energy density within the product footprint has increased significantly, meaning increased heat in the data center infrastructure.

Computer rooms require precise and adaptable temperature control:

- **Need for cooling.** Data centers have a dense heat load, generally 10 to 30 times the heat density of normal offices.

- **Cooling must be delivered where needed.** The heat load varies across the area of the computer room, and the air conditioning system must address the needs of particular heat-producing equipment.

- **Data centers need precise cooling.** Electronic equipment radiates a drier heat than the human body. A precision data center cooling system therefore requires a higher sensible heat ration (SHR) than office areas. Most precision systems have sensible cooling between 85 and 100 percent, while human comfort systems normally rate much lower.

- **Controls must be adaptable to changes.** The data center heat load will change with the addition or reconfiguration of hardware. Also, exterior temperature and humidity can vary widely and will affect cooling capacities.

- **Data centers need frequent air exchange.** To create a precision-cooling environment, the air must be exchanged at an adequate rate. While a normal office environment requires only two air changes per hour, the high-density heat load in a data center requires as many as 50 changes per hour. Precision air

conditioners pass more than 500 cubic feet per minute (CFM) per ton. If not enough air is exchanged in a given time, the cooling air will heat up before reaching the equipment it is meant to cool, and problems could occur.

Airflow planning affects the placement of data center racks. The front-to-back rather than the side-to-side cooling model is a more efficient way to cool the racks since no open area to the sides of the equipment is needed for free cooling space. In the front-to-back model, cool air is drawn upward directly through the perforated air distribution tiles in the intake aisles (see Figure 1) from the supply plenum beneath the raised floor. The air flows from the front to the back of the racks as the arrows show. The heated air is then exhausted from the back of the racks at the exhaust aisles to the return plenum in the ceiling. To move air efficiently, the subfloor pressure differential should be at least 5 percent greater than the pressure above the floor. An air conditioning system with a cold plenum low, return plenum high flow is the optimal system.