The shift to cloud-centric data centers requires rethinking the power architecture.

Executive Summary
As organizations move applications to the cloud and reduce the number of legacy servers in their data centers, the importance of a reliable and stable Internet-cloud connection has increased. Maintaining stable and consistent power within the data center remains critical, but the scope of power protection has broadened to include more components. With the network serving as the primary path between users and applications, the focus of power management in the data center must shift from reliable server power to reliable network power, including not only the data center, but the entire route between the end user and the Internet.

Because power protection can seem mundane, it can be easily overlooked as data centers migrate from stand-alone servers to virtualization and cloud-based applications. IT managers can easily make the incorrect assumption that whatever worked for a room full of servers will be fine for a few racks of virtual machines. But, in truth, revising power architectures in data centers is an important part of making the transition to cloud-focused hybrid data centers.
Protecting the power that serves data centers, infrastructure hardware and telecommunication equipment is the best way to ensure that all the benefits of the cloud continue uninterrupted. This white paper will outline some effective strategies and solutions to protect power in modern data centers and maintain access to cloud resources.

The Tectonic Shift to the Cloud

Enterprise data centers are in the midst of dramatic changes. Virtualization has reduced the footprint of entire rooms of servers and mainframes into racks of more efficient host machines that are coupled to large storage arrays. A more recent wave of changes has been brought on by the easy availability of high-quality cloud-based applications, which deliver a variety of benefits, including reliability, scalability, flexibility, improved management and reduced costs. As enterprises have learned how to maximize these benefits, their reliance on this computing model has increased. The cloud has become an indispensable resource. Many organizations have adopted hybrid cloud models, in which they run some applications in-house while outsourcing others to a service provider. These hybrid data centers haven’t simply shrunk in size; indeed, they have also adopted different architectures. The critical goal prior to the cloud was keeping servers and storage-area networks (SANs) up and running. But the focus has now shifted to ensuring application availability, which includes more diverse components.

In addition to servers and SANs, data centers have more application and network appliances than ever before, more complex networking topologies and critical links to cloud service providers and other data centers. As the cloud has grown in importance, so has the need for a strategy that delivers secure power to the IT infrastructure. Without power to the data center and the network, an organization can’t make use of the cloud.

This need for secure power is heightened by the deployment of high-density blade servers throughout many data centers. The processing capacity of these blade servers makes them essential, while their higher cooling needs place greater demand on data center power.

These changes in data center architectures give IT managers the opportunity to re-think power protection strategies and to adapt them to differing requirements. Smaller and smarter data centers can do more with less power and can adapt their operation to changes in power supply. For example, servers and SANs can shift into power-saving mode to consume less energy and generate less heat (which saves power needed for cooling). And virtualization farms can easily perform load-shedding to shut down systems when power runs short or requirements for processing drop.

Better management of power in enterprise data centers provides greater resiliency and more economical operation in challenging environments.

Wireless: A Key Strategy for Survivability

In the past, IT managers paid little attention to securing the power for end-user systems and networking hardware. The reasoning was that there was no point in running reliable power in wiring closets, since users’ PCs wouldn’t have power during an outage. Thus, maintaining the building network was a waste of effort. However, the rise of wireless networking and notebook PCs in enterprise environments has changed the landscape. Most notebooks have enough battery life to ensure hours of autonomy, if not a full day. With a wireless network connection, many users maintain their productivity by employing enterprise applications (in the data center or in the cloud) even if building power goes off. IT managers who have installed Power over Ethernet wireless and telephony networks can keep users connected to both the (wireless) data network and the telephone network simply by protecting power within the wiring closet.

By power-protecting the wireless and telephony networks, IT managers can help some users remain productive even during a full-day outage.

Getting Started with Securing Power

A good first step in securing data center power is to assess the risks of downtime and determine how to minimize them. If a termination of IT processes results in the unrecoverable loss of critical data or serious inconvenience for stakeholders or customers, IT managers should focus on these areas first.

To address the need for runtime, enterprises should consider power protection based on uninterruptible power supplies (UPSs) that store energy in batteries or flywheels designed to keep systems running from the moment of the outage. These technologies will keep the data center operating for a brief time until a longer-term power source can be deployed.

IT managers also should determine which resources must absolutely remain in operation and how to make sure they get the emergency power they need in the event of an outage. This power protection generally comes from gas-powered generators or banks of batteries that begin operating in the first minute of an outage. These sources must supply sufficient power to operate cooling systems as well. A data center that remains in operation but without sufficient cooling risks overheating, which can permanently damage equipment.

Strategies for Maintaining Runtime

With hybrid data centers and cloud-based applications, IT managers are dealing with smaller and more distributed loads
in their data centers. This new reality encourages the use of more intelligent UPS systems and a higher level of integration between UPS devices and the data center hardware.

No matter what immediate power protection solution they choose, IT managers should make an effort to provide an integrated solution for power management, rather than one based on multiple independent devices within the data center. An integrated solution that can provide current information about the state and quality of power can serve as an input to other systems for intelligent power management and load-shedding decisions in a way that a fragmented collection of devices cannot.

After immediate power kicks in, the next step is to get generators up to speed. Going without a generator is a risky proposition, as it is unlikely that batteries alone will keep things running.

IT managers face an important decision in selecting a generator with the appropriate capacity. If an organization installs a generator that's too small, it won't be able to expand data center power usage at all. Most data center managers should err on the side of caution and oversize generation capacity to allow for growth or changes in usage patterns. For example, if an organization wants to extend data center power to additional networking hardware, a little extra capacity would be a wise investment.

**Handling Wiring Closets in a Cloudy World**

When cloud-based applications are critical, the entire path between the user and the Internet connection has to be protected. Wiring closets, especially those with Power over Ethernet switches for telephony or wireless, can be heavy consumers of power, with a fully loaded 48-port PoE switch drawing 750 watts of power or more.

One strategy for wiring closets is to use individual battery-powered UPSs, typically without generation capacity. This can give 15 to 150 minutes (depending on load and UPS capacity) of power protection following an outage. This is an easy solution, but it has drawbacks, including maintenance of the UPS and questions about what to do when the batteries run down during an outage.

A more resilient solution is to run protected power from the data center (or a centrally located large UPS) to the wiring closet. This is a more scalable solution when wiring closets are easy to connect. Because most buildings have wiring closets intentionally stacked on top of one another, getting protected power to wiring closets may not be difficult.

**Smart UPS: New Tools for Protecting Power**

Power protection technology for data center and cloud connectivity has changed significantly over the years. The growing number of data centers that require power protection has fueled an upsurge in innovation at all points in the spectrum. The result: smarter UPS systems that are more efficient and manage power better; greater manageability and alerting capabilities; and greater awareness of power protection issues on the part of equipment vendors.

**Smart UPS devices manage power more efficiently.** While the UPS's primary job is to provide power in the case of an outage, it is an always-on part of the data center infrastructure. Efficiency in the UPS translates directly to a lower energy bill and lower cooling requirements.

The traditional trade-off in smaller UPSs (up to about 5,000 watts) is between on-line double-conversion devices on the one hand and line-interactive (sometimes referred to as standby) devices on the other. Double-conversion UPS systems offer advantages in environments where the quality of the power supply is poor.

But in markets, such as the United States, where the quality of the power supply is consistently good, line-interactive devices are preferred. These devices are more efficient and less expensive because they aren't performing the double-conversion task of constantly converting power from AC to DC and then back to AC.

However, these devices are impractical at the loads typically seen in data centers (above 5,000 watts), especially in facilities with heftier blade servers that support virtualization and larger SANs. To bridge the gap, UPS engineers have developed more advanced devices, usually called “delta conversion” UPSs, that scale up and provide high-quality power regulation while avoiding the inefficiency of on-line double-conversion devices.

IT managers at midsize data centers may be tempted to use a large number of smaller UPS devices to gain the efficiency and cost savings of line-interactive and standby UPSs, but this comes at a huge maintenance cost and has significant scalability and flexibility constraints. A better solution is to use newer, more efficient delta-conversion UPSs that handle data center loads in a flexible manner with a minimum of maintenance costs.

**Smart UPS systems also integrate better into data center, cloud and virtualization infrastructures.** In theory, a UPS maintains power in the data center only for a few minutes while generators are started. In practice, generators can fail, and UPSs may be used in environments where power generation is not available.

Originally, UPS devices either simply went offline when their batteries were exhausted, or they would communicate over a serial port to a single system. Today, smart UPSs have Ethernet ports as well as small CPUs, and they can send alerts via email, SNMP and other protocols to alert IT managers about power issues, battery condition, maintenance and other important status elements.
In nongenerator environments that may include critical cloud components, such as wiring closets or branch offices, smart UPS systems can also help in power shedding — shutting down noncritical equipment when utility power is compromised — with internally switched outlets. In heavily virtualized data centers, extra time may be needed to migrate or safely shut down virtual machines, making tight communication between UPSs and other infrastructure critical to nonstop operations.

**Smart UPS devices mesh better with virtualization and power-aware servers.** With private and public clouds everywhere, server manufacturers are now more focused than ever on efficient data center operations and are considering power management as a necessary feature.

The standard A/B power rails in all modern servers are now being joined by firmware-level power management. This usually includes the ability to reduce power consumption by reducing server performance and to more easily move between active and standby states, a feature that is now integrated into high-end virtualization platforms.

### The Near Future of Cloud and Power

Many enterprises are leveraging converged infrastructure, which combines numerous IT components — servers, storage, networking and software — into a single, optimized solution. This concept can enhance manageability and flexibility in an IT environment. Organizations that have deployed converged infrastructure use it as the basis for an eventual leap to the cloud. The model works well for both private and hybrid clouds, in which sensitive data and applications remain under the control of the organization. Combining a converged environment with the cloud can improve data center efficiency as well as disaster recovery.

Some vendors are now adding power protection to the core elements of converged infrastructure. These systems may include an intelligent UPS, a power distribution system and software that allows for comprehensive power management. The integration of a power management system allows IT managers to view and manage the entire power system from the virtualization dashboard through which they run the data center infrastructure. This model also enhances data integrity, business continuity and resilience.

To learn more about CDW’s data center power and cooling solutions, contact your CDW account manager, call 800.800.4239 or visit CDW.com/datacenter.