Getting the most out of the network closet

Executive summary

Although network closets come in different shapes and sizes, they share the fundamental purpose of serving as an essential arm of the data center. Because network closets house critical components of mission-critical environments, it is imperative that they be efficiently and effectively organized, protected and managed. This is especially important as IT professionals are tasked with keeping the technology infrastructure inside these closets functioning, even in the face of constrained resources and increasing complexity.

By selecting the optimal rack and power infrastructure, and pairing it with management hardware and software, organizations can bolster uptime and ensure operations remain up and running. This white paper will demonstrate how companies can save time and money while avoiding risk simply by organizing, protecting and managing the equipment within their network closets.
The network closet: One size doesn’t fit all

Whether at a small company, a mid-market organization or a large enterprise, the primary components that comprise a network closet are typically the same: switches, servers, storage, and the associated virtualization and management software. A fifth element that is often included is an integrated rack and power distribution system.

What differentiates one network closet from another is its main purpose. For smaller organizations, the network closet generally serves as a computing hub, containing all of the networking, storage and computing power needed to run the business. However, in larger organizations, the network closet often operates in conjunction with others, providing a connection to a centralized computing hub in the form of a server room or data center. In effect, larger organizations rely on network closets to provide a gateway to a centralized server room and then route information to a data center for storage. Today, the two primary types of network closets include:

- **Edge computing network closets:** The adoption of edge computing topologies in applications such as grocery stores, gas stations and fast food restaurants has changed the role of the smaller network closet, making it the key link to a company’s ability to connect to the internet and the cloud. These spaces typically house on-premise devices used to help manage the LAN and a few servers kept on-site to manage data security or application latency.

- **MDF/IDF network closets:** MDF and IDF closets, on the other hand, represent an integral part of a distributed IT system, specified and designed to be branch circuits of the IT distributed network throughout a building or campus facility. IDFs are often used for telephone exchange central office, customer-premises equipment, wide area network (WAN) and local area network (LAN) environments, among others. These spaces are generally office-size closets that support an entire floor of employees, typically housing equipment in traditional two- or four-post racks.

Regardless of the size of the network closet, when building out a new space or assessing an existing one, it is best to think in terms of three goals: organization, protection and management.

Organization

Given the tight confines of a network closet, optimal organization of equipment is essential for efficient operation and ongoing maintenance. In addition, to maximize uptime and increase reliability, it is important to adhere to proper rack hygiene, the practice of organizing cables and efficiently managing power so a racked environment is properly controlled and maintained.

Organizational equipment that can provide order to a network closet includes open-air racks (two- or four-post models), accessory racks, wall cabinets for cable equipment, strain relief bars, and cable management options for organization and airflow management purposes. Equipment racks with a two-post open-frame design are most common in network closets, but for deeper and heavier equipment, consideration should be given to using a four-post adjustable-depth equipment rack. Standard racks are typically 84” tall, but if space is at a premium, larger (96”) racks might be a consideration for maximum space utilization. It is important to use racks that are compliant with the EIA/ECA 310E standard for 19” or 23” rack mounting to ensure uniformity and ease of installation. In addition, racks that include rack mount unit (RMU) markings permanently embossed on the rack rails make the equipment installation faster and more efficient. Last but not least in importance is the weight capacity of the equipment rack. It is recommended that the equipment rack support at least a 1,000-lb (454kg) static weight capacity to ensure a stable support environment for expensive datacom servers, network switches and other equipment.

While rack design is important, when outfitting a network closet, it is critical to keep servers, switches, and storage equipment safe and secure. To aid maintenance efforts, as well as streamline troubleshooting, the rack area should be kept clear of cluttered data, power and network cables. For this reason, cable management is critical. A vertical cable manager should be placed on the end of each rack. One horizontal (1 RMU) cable manager is recommended for every 24 patch cables and one (2 RMU) horizontal cable manager for every 48 patch cables in a rack. Proper cable support is vital to ensure maximum performance and to facilitate efficient modifications, additions or changes to network cabling systems.
Monitoring and managing the infrastructure is critical to effective network management, but these activities alone are not enough to optimize network closet operations. Network administrators must also pay close attention to rack hygiene. Not only will the right cable management solution save time and money by increasing airflow and improving accessibility to closet hardware, but the practice also helps to avoid the risk of hardware failures due to accidental/inadvertent power cable removal.

Color-coded cables, vertical and horizontal cable organizers, cable spools, outlet plug retention and locking plugs are rack hygiene measures that help network administrators maintain proper connections and streamline problem resolution. Efficient cable management through the use of vertical and side cable management channels can increase airflow in the network closet, as well as ease any moves, adds and changes made to the rack. As a result, the chance for disruptions due to issues with the environmental temperature or accidental dislodging of a cable is reduced. A rack PDU with IEC plug retention prevents the accidental dislodgment of a plug, greatly enhancing reliability.

Furthermore, essential to cable management best practice is the ability to organize like cables—blue data cables with blue data cables, for example—to improve troubleshooting, eliminate clutter and reduce the potential for interference between different kinds of cables. Using dividers, it is possible to store power and networking cables within a single organizer and still maintain cable performance. This will allow for quick troubleshooting on the fly—should an unexpected interruption take place. Want to take it a step further? Standardize on a color pallet for each set of cables for the data center or closets site wide—orange for fiber, blue for data, red for A feed power cords and white for B feed power cords as an example.

**Figure 1.** Rack PDUs with IEC outlet grips can reduce the risk of plugs getting bumped loose and leading to server shutdown.

**Figure 2.** Color coded cabling allows for quick recognition of origin, route and connection point.

If you aren’t sure how many C13 and C19 outlets you will need, look for a PDU that enables flexibility with universal outlets.
**Protection**

In addition to cable management, power is another critical component needed to ensure uptime and avoid risks within network closets. Because reliability, availability and efficiency are critical, properly protecting equipment will save time and save money while reducing common threats. Recommended solutions include an uninterruptible power system (UPS) to provide emergency power in the event of a utility failure, a rack power distribution unit (PDU), and hot-swap maintenance bypass units that enable power to be switched directly to equipment to perform maintenance or replace a UPS.

To ensure maximum uptime and reliability within the space, a network closet ideally should contain redundant UPSs and PDUs to protect both primary and redundant equipment power supplies. However, not all network closets require fully redundant protection; by mixing and matching UPSs with PDUs, administrators can devise the right level of protection to suit their individual needs. Figure 3 shows the three most common levels of protection.

Keep in mind that an organization’s long-term efficiency and effectiveness goals can be compromised if UPS and PDU options are selected that do not create value by saving time, money and risk avoidance.

Beyond deploying the standard UPS and PDU, there are several additional protection options for the network closet that can bolster. If redundancy is a requirement, automatic transfer switches (ATSs) that automatically transfer power from a primary power source to a secondary source in the event of a power anomaly should be provided. Consider using ATSs and a maintenance bypass switch. For protecting single-corded equipment, an ATS is particularly useful as it maintains redundant power distribution to equipment in a rack with one or two power supplies. An ATS transfers power from a primary source to a secondary source when problems occur, and subsequently transfers it back once the primary source is restored.

Protection can be further enhanced by the use of intelligent rack PDUs that protect equipment within a rack by monitoring and managing power at outlet level. Integration of UPSs and intelligent rack PDUs with management software allows IT professionals to view and control the environment from any computer connected to the network server.

In addition, a maintenance bypass switch can be highly effective as it enhances availability to the rack by routing utility power around the UPS and into the PDU. If a UPS needs maintenance or replacement, the maintenance bypass switch allows power to be switched directly to the network closet equipment, eliminating the need to shut down the equipment during any repair or maintenance procedures.

For organizations that require extended runtime, additional battery modules can be added to the UPS. This is especially important in environments with stringent service level agreements, as extended battery modules will deliver more runtime during a power outage and provide sufficient time to migrate data in a virtualized environment. Ideally, an extended battery module designed to pair specifically with a UPS can ensure an installation that is trouble-free, while delivering a reliable backup solution.

When choosing a rack and power management and distribution solution for a network closet, keep in mind the various aspects related to return on investment (ROI). Achieving efficiency and effectiveness can be compromised over the long term if UPS and PDU options are selected that do not create value by saving time, money and risk avoidance.
To make the most appropriate choice, consider the following factors that affect overall ROI:

- **Rack organization**: Keep equipment secure and in place to optimize time and money spent on maintenance, as well as any future planning.
- **Power rating**: Pay attention to wattage measurements, as these reveal real power.
- **Network card**: Determine whether the UPS price includes a network card.
- **Output receptacles**: Be sure the UPS and PDU have enough output receptacles to accommodate the power cords of servers and other network closet equipment.
- **Input plug**: Some UPSs and PDUs have input plugs that fit into a standard wall socket. If not, an electrician may be needed to install a new wall outlet.
- **Batteries**: Consider the cost of additional battery packs, as well as the cost and frequency of servicing UPS batteries.
- **Software**: Make sure UPS and PDU software can integrate with existing virtualization management software.
- **User interface**: An intuitive LCD can streamline troubleshooting and save maintenance costs.
- **Mounting hardware**: For mounting a UPS in a two-post rack, look for included mounting hardware. Also be sure to pay attention to mounting bracket requirements for PDU installation.
- **Maintenance bypass**: Purchasing this switch can save money and avoid risk by allowing IT equipment to stay up and running in the event of a UPS failure.
- **Voltage**: From an energy utilization standpoint, a 208-volt UPS costs less than a standard 120-volt UPS, so make sure the proper voltage required is considered upfront.
- **Warranty**: Factor in the duration of the warranty and whether batteries are covered.

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**Eaton products to support your network closet**

**Organize with:**
1. Two-post rack
2. Rack shelf
3. Cable managers (vertical and horizontal)
4. Overhead cable tray
5. Rackmount PDU
6. Wallmount rack enclosure (MiniRaQ)

- Rack or wallmount all servers, switches and storage equipment to keep it safe and secure
- Clear the rack area of cluttered network cables
- Improve airflow and reduce cooling costs
- Secure equipment from unauthorized access

**Protect with:**
7. Compact rackmount UPS (16-inch depth)
8. Rackmount UPS with extended battery module
9. Automatic transfer switch or maintenance bypass
10. Wallmount UPS (1U lithium-ion UPS shown here)
11. Preventive maintenance and advance exchange warranties

- Distribute clean power to IT equipment during power outages, surges and voltage problems
- Provide reliable and redundant power solutions
- Maintain service level agreements
- Protect server workloads with Eaton software, whether you’re moving to available internal servers or a cloud-based backup recovery site
- Reduce vulnerabilities with a UL and IEC certified network card

**Manage with:**
12. Environmental monitoring probes
13. Water sensor
14. Power management software
15. UPS network card (with UL/IEC cybersecurity certification)

- View your power network and all equipment attached to it from your remote/virtual machine console
- Aggregate multiple UPS/power instances
- Monitor your environment’s temperature and humidity
- The Gigabit Network Card improves business continuity by providing warnings of pending issues and helps to perform orderly shutdown of servers and storage
- Initiate a virtual machine move or graceful shutdown in the event of an extended outage
Management

While the primary objective of a network closet varies depending on the size of an organization, the need to efficiently and effectively manage the included assets is universal. For a small company, all IT components may be contained within a single closet, but in larger organizations, IDF/MDF deployments may be spread across multiple buildings or even across a campus. Regardless of size, efficiently managing closets is critical to ongoing operations—and becomes even more important as the number of deployed devices grows. In recent years, this challenge has increased for IT managers due to the continued expansion of edge deployments, in which IT equipment is frequently deployed in applications where networking-savvy individuals are not on-site to troubleshoot IT equipment issues.

Organizing the network closet and protecting the IT equipment within provides efficiency and reliability up to a point, but for true optimization, IT managers require effective remote power management capabilities. Through a combination of both the proper hardware and software management products, IT staffs can effectively manage their growing network environment without requiring personnel on site. From a hardware standpoint, UPS and rack PDU products capable of SNMP communication offer a great way to improve reliability. Once connected, these products can provide remote notification and monitoring around outlet-level current metering, breaker status and backup runtime availability. But this is just the tip of the iceberg for remote management; adding ancillary hardware such as an environmental sensor allows temperature and humidity monitoring within these environments as well.

Once the hardware is deployed, IT personnel can focus on their networking ability at a granular level. Starting with the UPS, network administrators are able to keep close tabs on power consumption and backup runtimes in closet applications. By planning upfront and understanding how much runtime is available, administrators are able to respond quickly and effectively in the event of power disruptions and even identify potential trouble spots prior to failure. Networked rack PDUs can provide even more insight through outlet-level power consumption and the ability to cycle power on and off remotely, which can be a time-saver over having to perform a manual shutdown or restart equipment during or after an outage from within the closet. For organizations that have added closets to scale up or scale out their existing environments, it is also important to focus on environmental conditions. For example, a college may have network closets located in various buildings throughout the campus. It is not unusual for many of these closets to reside in converted spaces not originally designed for computing, a particularly common occurrence in many retrofit edge deployments. Because of this, these environments are inherently unfriendly from a temperature and humidity standpoint. If extra cooling cannot be added to the network closet space, remote management can help reduce the risk of the space becoming too hot. It is also important to keep in mind that in the event of a power outage, there will be no air conditioning supporting the application, making these alerts critical so personnel can determine when to remotely power down equipment.

Conclusion

No matter how big or small an organization, the network closet is an important element that keeps a business running. With reliability and redundancy paramount, organizations can equip their network closets with the optimal hardware and software to maximize uptime, improve efficiency and reduce operating costs—goals that, when achieved, deliver the highest ROI. By keeping organization, protection and management top of mind in the rack, a network closet can deliver the reliability and performance demanded by today's computing environments.

About Eaton

Eaton's electrical business is a global leader with expertise in power distribution and circuit protection; backup power protection; control and automation; lighting and security; structural solutions and wiring devices; solutions for harsh and hazardous environments; and engineering services. Eaton is positioned through its global solutions to answer today's most critical electrical power management challenges.

Eaton's mission is to improve the quality of life and the environment through the use of power management technologies and services. We provide sustainable solutions that help our customers effectively manage electrical, hydraulic, and mechanical power—more safely, more efficiently, and more reliably. Eaton's 2020 revenues were $17.9 billion, and we sell products to customers in more than 175 countries. We have approximately 92,000 employees. For more information, visit Eaton.com.