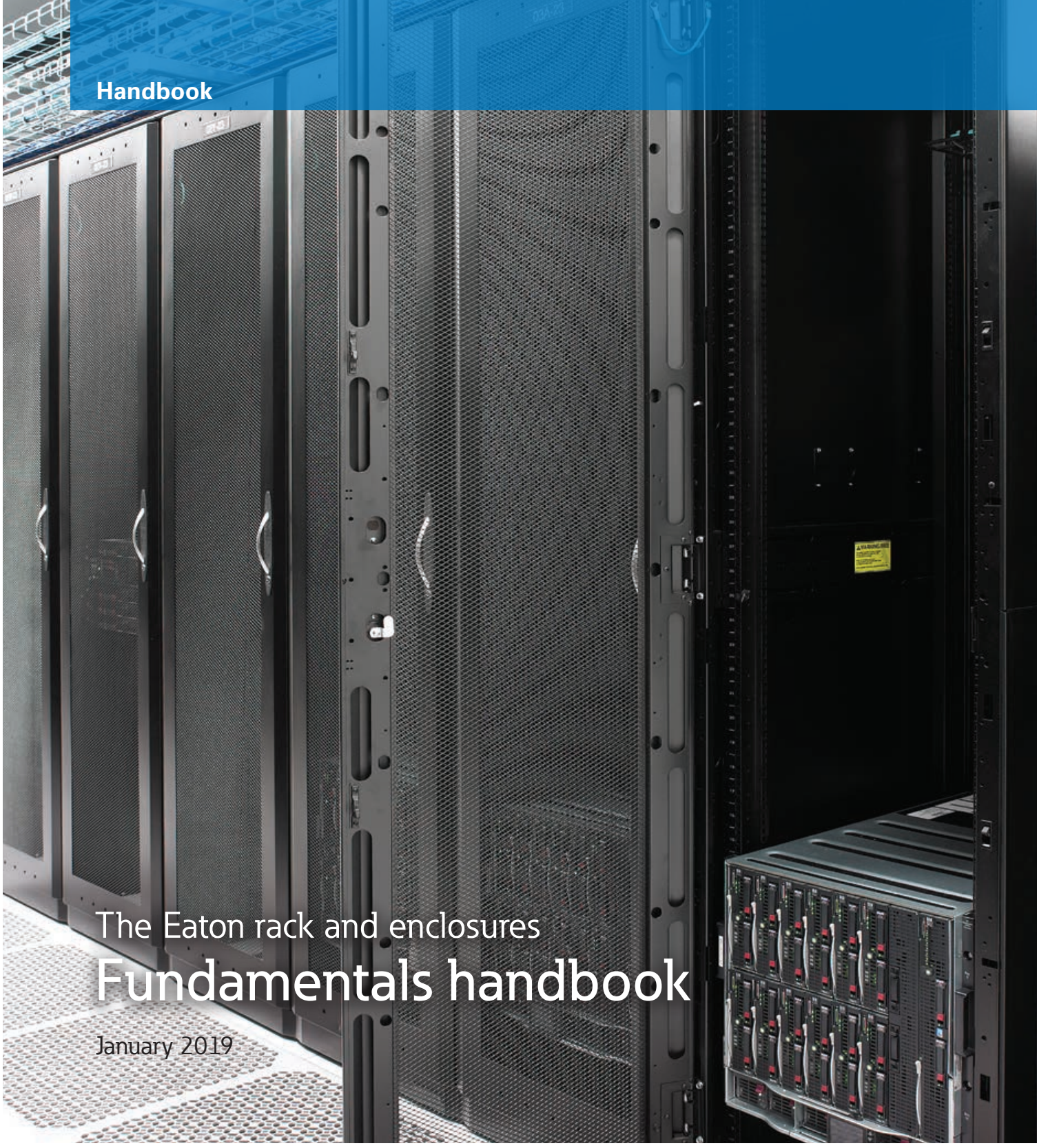
Handbook



The Eaton rack and enclosures

Fundamentals handbook

January 2019

Powering Business Worldwide

Switch ON to Eaton.

Table of contents

Introduction

Store	Protect	Cool	Power	Manage	Secure
Your critical IT equipment					

Welcome to the Eaton rack and enclosures Fundamentals handbook

This handbook is meant to help you choose, organize, and manage your racks and enclosures. In an effort to help you make the best selection for your requirements, we'll cover some of the components within racks and enclosures as well as some tips on deploying them. Everything is interconnected, so the more you plan in advance, the better prepared you will be. For instance, it is important not to overlook power and data cables. Tangled cables can cause downtime or impede productivity, and the more racks and enclosures you are deploying, the more important an effective cable management strategy becomes.

Since racks and enclosures are among the first pieces of equipment you choose to deploy, we want to help you avoid any decisions that may result in poor performance. Poor design can also result in overcrowded, overheated and poorly organized network closets, server rooms or data centers—and the all-too-likely outcome of that is downtime for your operation.

Rack types

Two-post, four-post, divider panels, baying or ganging, wallmount . . . There are so many items to consider when choosing a rack or enclosure that it can be a bit overwhelming to decide which solution is best for your IT environment.

Two-post rack

The two-post rack is the most simply designed, featuring an open frame that allows for vertical rackmounting of equipment and offers full and easy access. As the name suggests, the rack is constructed of two vertical steel posts joined together by top and bottom cross members, making installation and equipment maintenance easy. The two-post rack fits in tight spaces and offers flexibility when reconfiguring equipment and cables. Cable management and security products are available to help manage mounted equipment. Most often this solution is used for organization and ease of access for voice, data, and video (VDV) equipment.

One drawback is that with only two posts, it isn't the most stable solution for rackmounting a lot of equipment. However, most two-post racks include floor-anchoring accessories, recommended because they're holding up mission-critical equipment that is integral to your business operations.

Some highlights of the two-post rack include:

- Quick assembly
- Small footprint
- Lightweight
- Accessible

Ideal for network and telecommunications (VoIP) gear

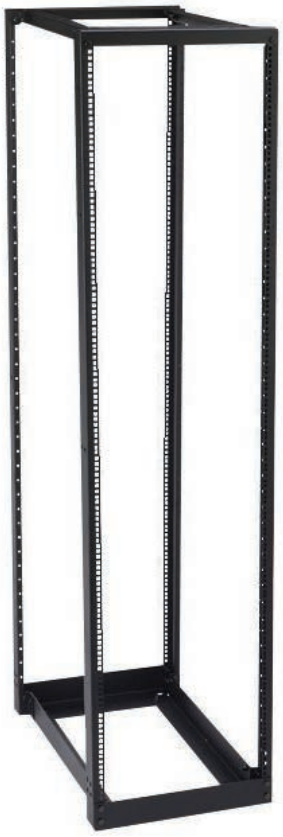
Four-post rack

The four-post rack is similar to the two-post rack with its open design, but it offers more stability. The open frame allows air to flow in and out of equipment freely. When shopping for a four-post rack, look for one with labeled U spaces, which helps when you install servers, network equipment, cable management, rack power distribution units (PDUs) and other accessories.

Some highlights of the four-post rack include:

- Ease of installation
- Increased stability
- Equipment accessibility
- Increased load rating

Ideal for cable-dense networking equipment



MY SEARCH FOR A STABLE RELATIONSHIP AND A HOUSE FOR MY DATA IS COMPLETE.

Enclosure types

Enclosure

Enclosures are essentially enclosed four-post racks with front and rear doors as well as side panels. Using an enclosure increases the security of your rackmount equipment. As you move from the network closet to server rooms and large data centers, enclosures are the primary rackmount solution for servers, uninterruptible power supply (UPS) systems and networking equipment. Removable side panels and doors, as well as rackmount rail kits that allow you to easily move equipment in and out of the enclosure, offer quick access while also protecting equipment from unauthorized entry. Additionally, with rapidly increasing power consumption and escalating heat output from IT equipment, an enclosure platform provides more flexibility to contain and direct the heat through rack- and aisle-based heat containment strategies including enclosure chimneys.

Some highlights of enclosures include:

- Enhanced security
- Controlled thermal management
- Aesthetic appeal
- Broader range of mounting options for accessories

Ideal for small server rooms and large enterprise data centers

Wallmount

If you're running a smaller operation and aren't in need of a full-size rack or enclosure, a wallmount enclosure may be an appropriate choice. This cost-effective and versatile solution provides secure storage of communications cabling, network gear, and related equipment on a wall—freeing up valuable desktop or counter space. Oftentimes, your "backbone" equipment is placed in a more public space—rather than in a network closet, server room or data center—so aesthetics and security can play larger roles. From an accessibility standpoint, dual-hinged wallmount enclosures offer diagnostic, maintenance, and service access from both the front and rear.

Some highlights of wallmount enclosures include:

- Protection from tampering and accidental unplugging
- Clear counters, desktops and shelves
- Adequate ventilation to keep equipment cool
- Optional fan kits and intake air filters

Ideal for manufacturing and production environments, small/remote offices, retail, security offices, etc.

SEISMIC CONFIGURATIONS?
I NEED THAT FOR MY NEST!

If you are in a seismically-active region (see page 29), most racks and enclosures are available in seismic configurations or with appropriate accessories to meet local requirements.

Rack and enclosure considerations

Racks and enclosures can be found everywhere. They are in airports, stores, healthcare facilities, manufacturing and production environments, schools, and enterprise data centers, to name a few. They are available in different heights, depths and widths, but one thing is certain: there is a solution for whatever equipment you're looking to store, protect, cool, power, manage, and secure.

Whether you're building a new space or optimizing and retrofitting an existing one, answer these questions to determine the best solution for your specific requirement.

Space and environment

- Where do you need to secure equipment? (e.g., Is it in a separate room or an open area where many people have access to it?)
- How much open space do you have in this area? (Think in terms of width, depth and height as that will impact your ultimate solution.)
- What set-up do you have in mind? For example, do you want to place multiple racks side-by-side? Or will they be stand-alone?
- Will you need to easily move your rack or enclosure or will it be in a permanent location/layout?
- Are you in a location with significant vibrations (e.g., near an airport) or one that's prone to earthquakes?

Equipment and cabling

- What equipment will go in the rack(s)?
- Will equipment be kept under lock and key at the rack level?
- How wide, deep and tall (U height) is the equipment going into the rack?
- Do you anticipate adding more equipment in the future?
- How are you connecting the equipment together from a cabling perspective?
- Will you need to run cabling across multiple racks? If so, how do you plan on doing that?
- Will you need access to the rack from the bottom or top for cabling purposes?

Other considerations

- Will you use rack power distribution units?
- Will you need back-up power for your IT environment—either rackmount or free-standing?
- Do you have a way to remotely monitor the environment and temperature 24/7?
- Do you have power management software to help monitor equipment and migrate virtual machines in the event of an extended power outage?
- How will you keep equipment at an ideal temperature?
- Do you need airflow management accessories to accent what you're already doing?

When you're prepared to get more technical, visit page 21 for the solution worksheet.

Typical application infrastructure requirements

From the 1 kilowatt (kW) network closet in your local dentist's office to today's large social media and ecommerce companies that design and deploy "web 2.0" megawatt (MW) data centers, data center definitions vary as do the power protection solutions they deploy.

Here's how Eaton defines applications:

Network closet	Small and medium business data center	Large traditional data center	Colocation data center
• <15 kW	• 20–500 kW	• 500 kW–5 MW	• 1 MW–20 MW
• Gateway to the Internet or internal data center • Typical IT equipment like servers, UPSs, PDUs, switches/routers, patch panels	• Networking, storage, Internet gateways are common requirements	• Risk adverse, highly redundant data centers • High availability • Security generally at the facility level • Focus on efficiency/power management	• Unpredictable power and cooling needs due to multiple customers • Security is a key concern at the cabinet or pod level • Wide range of IT equipment requirements
• 1–10 racks	• 10–100 racks	• 100+ racks	• 100+ racks
• Two- or four-post racks for closet environments (equipment weight is a key criteria for selection) • Wallmount enclosure for small installations (generally 12U or smaller) • Cable management to get cabling to rack	• Small enclosures (12U to 36U) • Perforated doors to facilitate airflow • Supports power, backup and IT equipment needs • 42U and taller racks for larger offices and small data centers	• 42U to 51U enclosures • Handle wide range of IT equipment including servers, storage and power • Compatibility with rack- and aisle-based containment often critical • Security is generally via a key lock • Cable management in, above and below rack is key	• 42U to 51U enclosures • Unpredictable power and cooling needs due to multiple customers • Security a key concern at the cabinet or pod level • HFID locks often needed for access control • Compatibility with rack- and aisle-based containment often critical • The partitioned nature of colocation data centers often require data center cages **(find out more at Eaton.com/racks)**

Interact with different environments by visiting:

- **Eaton.com/networkcloset**
- **Eaton.com/serverroom**

Tips for cable management

When the data and power cables in your network or server rack look like tangled vines, the lack of organization can lead to accidental disruption of service. An organized rack decreases human errors, increases efficiency and better protects equipment by increasing effective airflow, particularly in an enclosure. By using the correct cable management accessories to organize, route and remove unnecessary stress on your cables, you can better ensure data integrity.

Racks and enclosures can become disorganized quickly if cable management doesn't remain an ongoing priority. As a critical point of interconnection within your business, follow these tips to ensure optimal performance of your mission-critical IT equipment.

Organization

- Study the different cable accessory options to find out what will work with the equipment in your environment (cable trays vs. lacing bars vs. ring managers, etc.). View the glossary on page 24.
- If you have more than one rack or enclosure, establish a standard for uniformity to keep your operation running and maintain your sanity.
- Use Velcro rather than zip ties when bundling cables. It will make removal of cables easier.
- Separate data and power cables to minimize signal interference.
- Avoid running cables across the inside of a rack or enclosure. Instead, bundle cables, and run them vertically up the side of the rack or enclosure and across the top. This is where overhead cable management options come into play.
- Make sure not to block any equipment, as this can hinder serviceability and cause overheating and/or equipment damage.

Documentation

- Label or tag your cables on both ends to make troubleshooting easier.
- Be consistent in your labeling or tagging methodology.
- Group and color code your cables (servers vs. routers, etc.).
- Document your methodology, inventory, IP addresses, serial numbers and the roles of each device.
- Post diagrams on the side of each rack or enclosure.
- Take front and back pictures of the equipment to help with over-the-phone troubleshooting.
- Keep electronic and hard copy versions of your documentation.

Safety

- Limit employee access to racks and enclosures (and even the room).
- If a cable isn't being used, have it removed. Loose cables are a safety hazard.
- Limit the length of cables (the longer the cables, the greater the chaos).
- Avoid cables that dangle, which are a target for human error.
- Avoid extensive bending of cables; adhere to appropriate bend radius recommendations.
- Properly and securely install power cables to minimize arc flash risk.
- Make sure plugs are secure.
- Ensure cables are protected from sharp objects.
- Study industry standards and regulations on designing, installing and testing structured cable (e.g., TIA/EIA-568-B.1/2/3 bend radius standards).

Industry standards and regulations can be found through the

- American National Standards Institute (ANSI)
- Telecommunications Industry Association (TIA)
- Electronic Industries Alliance (EIA)
- Electronic Components Industry Association (ECIA)
- International Organization for Standardization (ISO)
- International Electro Technical Commission (IEC)
- Consult your local or regional Authority Having Jurisdiction (AHJ).

By employing some of these basic cable management strategies, you will save yourself a lot of headaches when it's time to add, remove or revamp the equipment in your rack or enclosure.

WHICH CABLE SHOULD I SWING FROM? IT'S A JUNGLE IN THERE!

Blanking panels: a best practice

Today's rapid technology refresh rates result in ever-increasing changes within racks and enclosures. This can lead to open U-space that allows re-circulation of hot exhaust air to the equipment inlet, particularly in an environment where enclosures are being used. Blanking panels provide a quick, easy and cost-effective solution to optimize air circulation within an enclosure while also maintaining a clean, uniform look within a row of enclosures.

Blanking panels are available in a variety of styles, with the most common being black plastic or steel. However, there are other options available—like adjustable and cable pass-through configurations—depending on your specific requirements.

In addition to sealing unused U-space in the rack, there are at least five other fault areas of an enclosure that can directly affect airflow management and cooling performance, as well as improve energy efficiency

Read more about these five fault areas in the next section.

Five fault areas of an enclosure

With a goal of zero airflow leakage within an enclosure—particularly in equipment-dense applications—it is important to know the most susceptible areas for the remixing of cold air supply with hot air exhaust from rackmount equipment.

1 Fault area 1: Under the enclosure (external to enclosure)

The area under the rack, but above the floor deck can be difficult to manage because the height varies based on the size of rack levelers or casters and the manufacturer. This space can contain a substantial amount of uncontrolled air–and can therefore yield a large benefit if it's sealed appropriately.

Typically, there's not a solid panel under the enclosure due to the requirement for power and network connectivity. That also makes this is a potential leakage area because hot air from below the enclosure can get trapped and cold air from perforated floor tiles can bypass it.

2 3 Fault areas 2 & 3: Left and right side of the front 19" vertical mounting rail (internal to enclosure)

Because of customer demand for adjustable front rails and cable pass-thru capability, the areas to the left and right of the front rails on most 19" enclosures are potential leakage points. The space between the side of the vertical rail and the side of the enclosure frame or side panel is typically wide open, allowing hot air to penetrate or cold air to pass. This can severely compromise a robust blanking panel strategy.

Today's wider racks (i.e., 800 mm) have an additional three inches on each side of the 19" rails to provide space for cooling side-to-side switches or space for managing a high volume of network cables. To get out to the side or up to the top, cables are passed through openings that are typically unsealed. These openings should be covered with a material that provides a seal around the cables to minimize air leakage.

4 5 Fault areas 4 & 5: Above and below the top and bottom rackmount space (internal to rack)

Areas above the top U space and below the bottom U space are also regions of suspicious leakage. Typically, some amount of space exists in these areas and varies per rack manufacturer. However, it's not unusual for this space to equal that of a missing blanking panel.

This area is susceptible to hot air recirculation and is also more likely to allow bypass of the cool air supply from CRACs.

Rack hygiene

Rack hygiene cuts cooling costs and protects your valuable equipment against over temperature

Watch Professor Wattson's lesson on rack hygiene at: Switchon.eaton.com/power101

Racks and enclosures are more than a space to store high-performance servers, storage and switches. They have become an instrumental part of today's critical airflow management strategies in the data center.

As virtualization becomes a standard for businesses to reduce the operating costs associated with consolidation of server, storage and network devices, it's further driving the view of an enclosure as an airflow plenum.

The amount of heat has increased within the enclosure and data center too, thanks to new IT technology and smaller rackmount equipment. Additionally, the number of cables within the enclosure has grown significantly, resulting in potential airflow blockages if they are not managed and routed appropriately.

Ideally, cool supply air is drawn into the front of the enclosure to cool equipment and exits via a rack-based chimney at the top rear of the enclosure or into a contained hot aisle.

Equipment becomes less efficient when the hot air travels back to the front of the enclosure and remixes with cool supply air that's being pulled through the equipment. The more equipment you store in your enclosure, the more you will need to consider this type of inefficiency.

Airflow mismanagement can result in failing hardware and unnecessary facility costs.

What is rack hygiene?

To ensure sufficient device cooling, predictable airflow management is essential, and this means all potential airflow openings must be controlled and managed—which is what rack hygiene is all about. Rack hygiene includes identification, analysis, and repair of hot air leakage paths and cold air bypass routes within and around racks.

1. Identify
2. Analyze
3. Repair
4. Quantify airflow leakage
5. Benchmark

Rack hygiene benefits

Adopting effective rack hygiene eliminates hot spots, which allows equipment to operate optimally, and helps match cooling supply and demand. This saves energy and prevents the wasteful recirculation and bypass air streams associated with additional "chaotic cooling" methods. Rack hygiene also helps to prevent aisle and room overheating, a problem that's often rooted in ineffective rack-level airflow management.

Airflow problem areas

Blanking panels must be a best practice in your data center, but are only one component of rack hygiene. Addressing the five typical fault areas can drive true performance gains: optimized enclosures used as an integral element of airflow containment systems can reduce energy usage by as much as 35 percent.

Rack hygiene in practice

Implementing rack hygiene starts with measurements to establish a baseline and testing to identify problem areas. Your goal should be zero airflow leakage. Implementing rack hygiene starts with measurements to establish a baseline and testing to identify problem areas. An experienced team trained in containment strategies should analyze the test results and provide detailed recommendations for improvements.

No place for intuition

Relying on intuition and creative problem-solving to achieve effective cooling is no longer a viable approach. Rack hygiene is an essential consideration for all future rack purchases. A smart containment strategy, which always begins with the rack, enables:

- Efficient utilization of existing physical infrastructure and cooling capacity
- Active control and normalization of supply temperature
- Doing more with less in a smaller footprint with increasing heat loads
- Elimination of "stranded" physical, electrical and mechanical capacity

BENCHMARK? WHAT ABOUT BENCH PRESS?

Nine benefits of rackmount PDUs

Rack power protection and control are key components of optimizing your rack, the room that it resides in and the business that depends upon it.

Rack power distribution units (also known as rack PDUs or Eaton ePDUs) are a key part of an integrated system that protects the equipment within the rack. The right unit can allow you to monitor and control the power at the individual outlet, switch power on and off, remotely shut down the power during an emergency power outage, or simply distribute power efficiently and safely. Rack PDUs can deliver the customization and protection capabilities you need within your rack.

This hot-swappable meter board allows for service with no interruption to the load

Here are nine benefits you may have not known about rack PDUs.

1. They enhance the reliability of your IT installation.

Even a sophisticated power infrastructure designed to guard against unplanned downtime and data loss can be threatened with a simple accidental plug disconnect. To guard against this, some rack PDU suppliers have developed a plug retention feature that takes up no extra space and delivers maximum reliability without the drawbacks of older solutions.

2. They tell you where your energy is going.

Rack PDUs can provide energy monitoring right down to socket level, if required, and they can measure energy usage with ±1 percent billing grade accuracy. This means users can quickly determine exactly where energy is being used and ensures rogue hardware that's consuming more energy than it should is quickly identified. Accurate metering also simplifies load balancing and reveals locations where there's spare power capacity.

3. They help cut your cooling costs.

The trend to use less cooling means higher temperatures in the rack enclosure. Older rack PDU systems may not be able to cope and make it necessary to provide additional cooling, but new generation PDUs can work continuously at up to 140°F.

4. They simplify maintenance and upgrades.

Older rack PDUs often get in the way of other rackmount hardware, making it difficult, for example, to hot-swap server components in order to maintain operational continuity or to install hardware upgrades. The latest PDUs have a low-profile design, which allows full access to all rackmount equipment. In addition, they incorporate hot-swappable components such as meter boards, which can be fitted or exchanged without interrupting the supply to the loads. As an additional benefit, the best rack PDUs are color-coded so maintenance technicians can see at a glance which circuit breaker controls which socket.

5. They put you in control of your power.

With switched rack PDUs, users can remotely turn the power on and off to individual socket outlets. The switching can be carried out manually or under the control of power management software. This makes it possible to disconnect non-ains supply failure so UPS runtime is maximized. It also means individual servers can be remotely restarted to help restore normal operation after a problem, and servers can be completely shut down when the demand is light, outside normal working hours.

6. They simplify administration of your power system.

Today's rack PDUs support mass configuration and updating, which keeps the time needed for power system administration to a minimum. Changes, which occur frequently in today's dynamic IT environments, can be implemented quickly, efficiently and with minimal risk of error.

7. They save you money on network components.

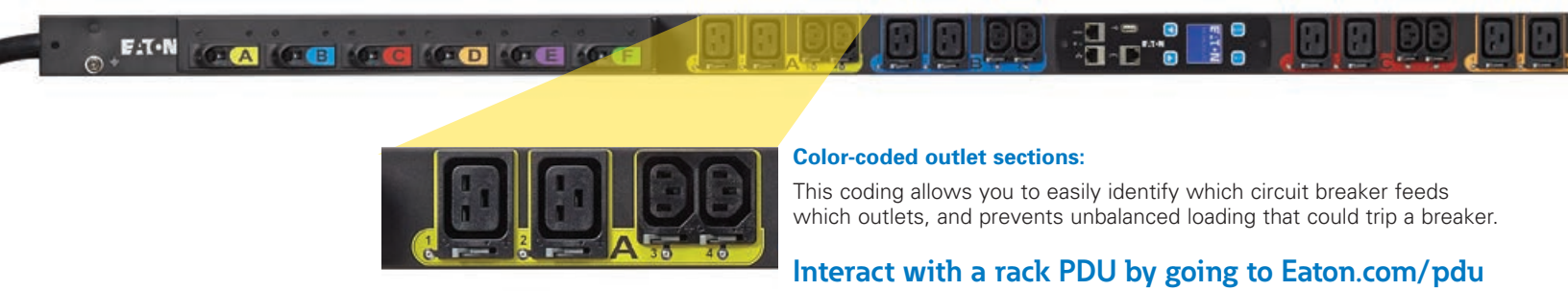
Network connections are essential for all advanced rack PDUs to provide access to their control and monitoring functions. With older types, a separate network port is needed for each PDU. This arrangement is expensive and unwieldy, as administrators have to deal with multiple IP addresses. The latest rack PDUs reduce physical infrastructure costs with daisy-chain network connectivity, where a single port and just one IP address can be used for multiple PDUs.

8. They provide you with on-the-spot status information.

Rack PDUs have integrated displays that can be rotated to suit the installation orientation and show key information, such as alarms, right on the device. This makes it possible to check the operation of the power system at a glance, and is an important aid to rapid detection and correction of faults.

9. They are convenient and flexible.

The best rack PDUs are easy to install and offer a choice of mounting positions. They're lightweight yet robust and their aluminum chassis dissipates heat efficiently and provides excellent ground conductivity.



Color-coded outlet sections:

This coding allows you to easily identify which circuit breaker feeds which outlets, and prevents unbalanced loading that could trip a breaker.

Interact with a rack PDU by going to Eaton.com/pdu

Sample configurations

Equipment configurations within racks vary, but the need for organization remains a constant. Here are some examples worth referring back to.

Sample: 24" wide x 40" deep enclosure

The layout places five servers in the upper half of this 45U enclosure and a 2U patch panel in the highest of U positions. On the left side of the enclosure is a vertical run of 48 cables that connect the equipment inside the enclosure to the patch panel.

Two rack PDU units are installed vertically onto the integrated vertical lacing bar on the right side of the enclosure. The input cords for the rack PDUs extend up and out of the top of the enclosure, which is typical for installations that include an overhead busway such as Eaton's Pow-R-Flex. The PDUs can also be mounted with the input cords facing the bottom of the enclosure, which is typical for installations that include a rackmount UPS, such as the Eaton 9PX.

Horizontal strain relief bars support data and power cables as they run from the sides of the enclosure to the power/data ports on the servers.

Figure 1. Typical cable management inside an Eaton cabinet

Patch panel: Horizontal management

Following best practices, the 48 cables are grouped by color to aid in identifying specific cables as they run to the left-hand side of the enclosure via a 2U horizontal ring manager. The cables then transition into a vertical run down the enclosure's integrated lacing bar.

This horizontal ring manager takes advantage of a simple cover to improve aesthetics inside the rack.

Figure 2. Cables organized through the use of colors and groups

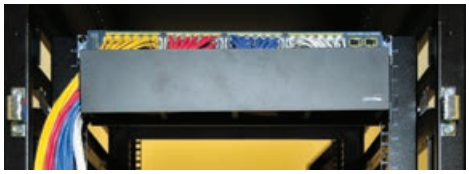


Figure 3. Careful use of covers improves aesthetics

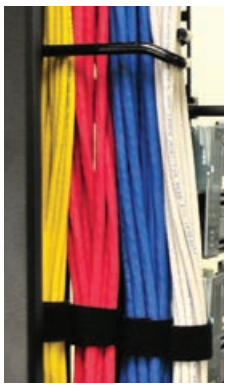


Figure 4. Cable rings and Velcro straps help to secure cables

Vertical management

The cable bundles are grouped by colors with simple Velcro straps. Cable rings installed against the vertical lacing bar support the bundles, as shown in Figure 4.

This lacing bar is integrated into the frame of the enclosure and provides ample space for the support of any number of cable management tools and power components. It's designed with a series of round holes used to secure cable management tools, as well as keyholes for tool-less installation of the rackmount PDUs.

Figure 5. Integrated lacing bar

Figure 6. Cable mounting from the vertical management raceway to IT equipment

Figure 7. Power connections to IT equipment

Power cables and rack PDUs

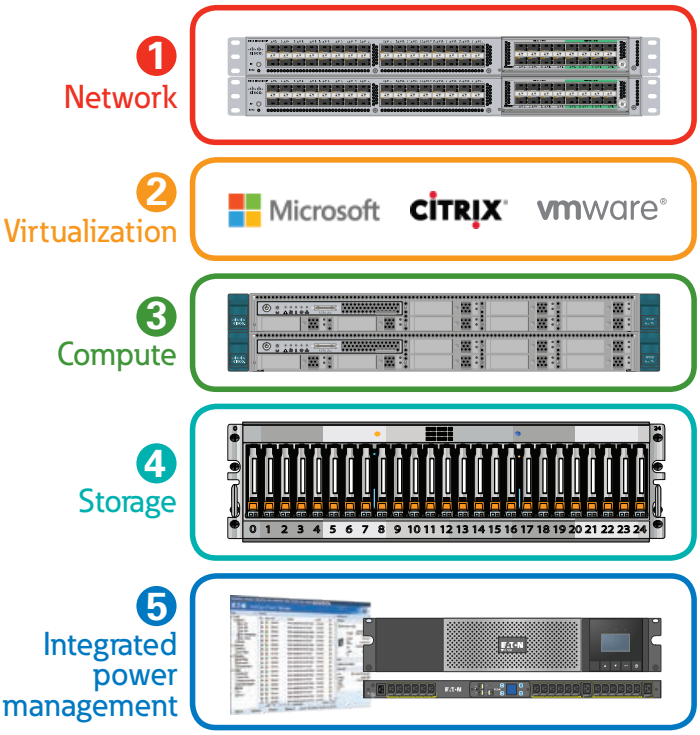
As shown in Figure 8, both rack PDUs are mounted on the right-hand side of the cabinet and leave ample space for the data cables while minimizing noise associated with mixing power and data cables.

The power cables are separated into red and blue to facilitate easy identification of the A and B power feeds and balancing the electrical load.

Figure 8. Eaton ePDUs for A and B power feeds

What is converged infrastructure?

Converged infrastructure (CI), also referred to as an integrated IT stack, is rapidly gaining popularity by allowing IT managers to reconfigure and expand their operations quickly, easily, and cost- effectively.



The term was coined to describe an IT solution that brings together storage, network, servers, and software in a convenient pre-integrated, prepackaged and centrally managed "building block."

The main goal is to minimize compatibility issues and simplify device management while reducing costs for cabling, cooling, power, and floor space. One of the big benefits is when the time comes to expand IT capacity, you'll just need more building blocks, which are fast and straightforward to deploy.

CIs are so inherently resilient that many IT professionals mistakenly believe that the solutions can be safely operated without a UPS backup. Unfortunately, that is a not the case, and power should be considered the fifth element of CI. When building your solution, ensure you use a best-in-class power management system to help you save time and money and minimize business risks.

Professor Wattson walks through converged infrastructure: Switchon.eaton.com/power101

1. Secure racks with airflow management.

A good power management system starts with a reliable and safe environment for critical IT equipment. The role of a rack is more than providing solid physical protection for equipment mounted in it; a good one also provides excellent airflow management. This cuts cooling costs and eliminates hotspots that can potentially reduce the life of the rackmount equipment.

2. Use highly efficient, network-connected UPSs.

Like all IT equipment, CIs are vulnerable to power spikes and other electrical disturbances and is susceptible to serious damage unless safeguarded by a UPS.

During a power outage, network-connected UPSs can provide that information by notifying down-stream devices that power is not available. Without UPSs, technicians must initiate the VM transfer process manually—which is much slower and far less reliable. In addition, a CI's failover capabilities become virtually useless unless a UPS is present to facilitate the necessary backup.

3. Power distribution that reduces energy consumption and increases reliability.

Outlet level metering in rack PDUs reduces energy consumption, which are ideally as accurate as ±1 percent.

It's not uncommon for plugs to get bumped loose, leading to unplanned and uncontrolled server shutdown, which can be controlled with rack PDU outlet grips.

Rack PDUs can also further reduce cooling costs if they can operate in high temperatures (up to 140°F). Some PDUs monitor temperature in the racks, giving you the information you need to identify problems and further reduce cooling costs.

4. Rely on power management software with integration into leading virtual platforms.

Integrated software can offer easy visibility of the entire solution through a single pane. In other words, all UPSs and rack PDUs in the virtual network can be viewed and managed from the same virtualization dash-board, together with network, servers, and storage devices. This eliminates the need for IT managers to run separate software to manage all their power devices seamlessly, saving time and reducing workload.

Eaton has worked hand-in-hand with CI architects including Cisco, EMC, NetApp and SimpliVity, to provide a powerful, integrated, and scalable solution for power protection and centralized power management. Our Intelligent Power Manager software and reliable UPSs let you view and manage your entire power system from your existing dashboard.

The truth about IT rooms

If you aren't working in an enterprise-level data center, there is a chance you are working out of a closet or a room that wasn't initially designed to house IT equipment. Even larger businesses that have remote enterprise data centers are often functioning out of IT or server rooms locally.

While you may not have much control over your building, the room still matters. Make the most of the space you're given, and you will protect your company and customers from unnecessary downtime.

Common challenges that are risking uptime:

- **Lack of security.** Even if you have a room that has locks and alarms, is your company using them to their potential and following procedures to monitor who goes in and out of the room?
- **Untrained staff.** It isn't enough to just have one person in the company who is trained to handle the equipment within your IT room. What if that person is unavailable or incapable of coming in when a disaster strikes?
- **Mother Nature.** Whether or not you're in a seismic zone or another area prone to natural disasters, you should consider the effects of storms and power outages can have on a business.
- **Unorganized cabling and environmental hazards.** Tangled cabling and unsafe rigging of electrical equipment is commonly found and easy to remedy. It can take significant time and effort, but the time and effort you will save on the backend will be well worth it. It's also worth noting that you want customers and senior management who walk by the area to be impressed by the organization and professionalism of the room.
- **Inadequate power infrastructure.** Power protection is more than just a UPS, but it's common to see little to no protection for the IT equipment in your network environment, which leaves the business with a very high risk of failure.
- **Limited management capability (both onsite and remote management).** Lack of visibility into what is going on in your closets can result in your network going down unexpectedly.

Let's take a look at some steps to improve your network closet or server room.

Step 1: Scouting out your IT room

1. Location, location, location.

Determining the location of the server room within the building is the first consideration. Oftentimes, room choices are limited, but keep this in mind: Most IT professionals agree that the room should not be constructed against exterior walls of the building, which are often damp. Furthermore, exterior windows are susceptible to being blown in or out by storm winds.

2. Size does matter.

While it's much easier to plan for an organization's current needs than to project growth, failing to factor expansion into the initial design is likely to cause problems down the road. Although projecting growth is often highly speculative, enterprise architects recommend planning five years out with a growth rate of 20 percent per year.

3. Seek higher ground.

The flooding threat posed by basement-level server rooms was underscored by the extensive damage suffered by many facilities when Hurricane Sandy pummeled the East Coast. For this reason, do not locate your server room in the basement. Instead, seek a higher and more central location that not only alleviates flooding concerns but can also help minimize cable run distribution.

4. Avoid waterworks.

Unexpected storm flooding isn't the only water threat for server rooms. Never back your space up to a "wet wall" containing any pipes or plumbing, as breaks or leaks can cause significant equipment damage.

5. Keep cool.

Make sure your server room is temperature-controlled. It's generally recommended that temperature inside a rack doesn't exceed 23°C (73°F). Sensors are best located in the server racks or enclosures rather than in the room, since ambient temperature will rise at a slower pace compared to the temperature in the rack or enclosure. Humidity also poses a great risk to equipment. Relative humidity (rH) in server rooms should remain around 50 percent with a ±10 percent margin.

6. Play it safe.

Don't overlook security concerns. If possible, construct your server room with no external entry points (windows or additional doors) and make sure it remains under lock and key.

7. Have an exit strategy.

Don't assume you'll never need to remove or replace any equipment. Installing a regular-size door can make maintenance a nightmare. Be sure the doorway will allow equipment of all sizes to enter without having to remove the door or frames. A 42-inch-wide by 84-inch-tall door should accommodate most requirements.

8. Get fired up.

While it's likely that the building surrounding the server room is equipped with a fire detection and sprinkler system, the room itself should have its own protection that utilizes an alternative such as a clean agent system—which extinguishes fires by removing heat—or inert gases, which essentially suffocate the fire by depriving it of oxygen.

9. Leave some breathing room.

Room for expansion isn't the only space consideration. If possible, allocate space both in front of and behind racks for easy maintenance access. If using enclosures, also consider split doors to minimize unnecessary blockage in the aisle when the door is open.

10. Divide and conquer.

Whenever possible, keep your server room's power supply and climate controls separate from the rest of the office space.

Step 2: Rack-based refresh strategy

Now that we've walked through the rack consideration checklist and room considerations, you have a better understanding of what you need to safeguard your IT investments. Next up is how to refresh your rack-based infrastructure. With the right plan in place, you can avoid the chaos that many fall victim to and establish an orderly and scalable IT room with minimized risks. When it comes time to upgrade your IT infrastructure, everything is connected. Here are some suggestions to getting the project underway.

1. Take inventory.

When evaluating your power infrastructure, calculate the entire wattage consumption of your current environment prior to making any changes. Are you replacing servers? Are there any other pieces of ancillary equipment that will need to be upgraded? Then examine your current power infrastructure by seeing how many existing UPSs and rack PDUs you have supporting your equipment. Once inventory is complete, you'll have a better understanding of what's required, the potential cost for upgrades and which equipment can still be utilized.

2. Examine performance.

Is your new deployment going to require any upgraded components to connect to the cloud? Are you planning on scaling out storage over the next few years? It's important to establish a standard now (including UPS systems) to ease future growth. Scaling has implications on compatibility and power infrastructure planning. Have you had any disruptions or alarms within the past six months? This may point to potential issues with your current deployment. Verify your existing UPS model and determine the age, efficiency, power factor, and the last time the batteries were replaced. Older UPSs may be costing you from an energy-consumption standpoint and aging batteries that need replacement may have you at risk for downtime.

3. Evaluate new IT equipment deployment.

If you have opted to stay on premise, how many new servers will you be deploying? If you're planning to migrate to the cloud, how many network switches require protection? Now that you have made the decision as to the legacy equipment that will stay, as well as the new IT equipment you'll be deploying, you can make an intelligent decision on the most appropriate power protection strategy for your new racks. Calculate the total wattage consumption for all new devices and combine them with your previous legacy calculation from step one, disregarding any equipment that's been removed.

4. Allocate the budget.

Once you've calculated the total wattage consumption for all planned devices in the new environment, you can now move on to selecting the right power protection solution, which will include racks or enclosures, cable management, UPSs, PDUs and software. Check with your facility or building manager to determine the available electrical options, as there may be some limitations that will impact your decision. Next, examine required backup runtime, determine if network-ready is a requirement and consider future expansion; then select accordingly.

Step 3: Building out your network closet

1. Don't trade long-term risk for short-term savings.

For protection, you want to distribute and provide safe clean power to IT equipment during power outages and surges. To provide maximum reliability, we suggest implementing redundant power solutions. Doing so will enable you to meet and maintain service level agreements with your manager or your customers.

Maintenance bypass is always recommended for server-class solutions and can easily double the reliability of a system by providing a strategy for unexpected downtime.

If you currently have traditional power strips, replace them with rack PDUs so power can be distributed intelligently and managed remotely.

2. Determine the most effective way to mount and install your IT equipment.

For smaller installations with less equipment, a wallmount rack or enclosure might fit the bill from a security standpoint to keep out unauthorized personnel. Wall mounting comes in handy when you're trying to elevate your equipment away from other potential hazards or you have limited space. If space isn't an issue, you may want to consider a two-post rack, four-post rack or full-size enclosure.

3. Select appropriate cable management options.

Velcro cable ties provide an affordable and reliable way of organizing your network cables and bundling them together. Vertical cable managers allow you to route cables down the side of the rack or enclosure and then segment them off accordingly based on the location of switches and servers within your rack or enclosure. Horizontal cable management also enables you to manage cables across the rack or enclosure to reach appropriate equipment. Combined, all three of these cable management accessories help you to easily add and remove network cables as required and are considered mandatory at minimum.

Other cable management options include cable spools, strain relief bars, lacing bars and waterfall devices to ensure appropriate cable bend radius.

4. Keep software in mind to optimize your solution.

For management, you want to be able to view your power infrastructure and all equipment attached to it from your remote or virtual machine console. This will allow you to monitor the temperature and humidity of your network closet environment and receive instant alerts in the event of an outage or environmental change. You can also initiate virtual machine migration or graceful shutdown in the event of an extended outage.

Step 4: Getting back to business

1. Discuss your plan with your team.

Make sure the entire IT team as well as senior management is on board. Open the conversation up to the group to ensure there was nothing left off the list. Set expectations, establish responsibilities for the installation and thoroughly review safety methods. Start communicating the importance of standardized work processes, including cable management strategies and overall IT behavior, to the IT staff now. Make employees aware of the plan as well in case they are affected by downtime.

2. Clear out the room and space.

Keep the room as empty as possible during the entire process, removing packaging materials, tools, parts and unused equipment. This is a good time to get exact dimensions of the space. Are there any physical obstacles, including structural columns, pipes or doorways that need to be considered in your space planning? How will you get the equipment in and out?

If you aren't building your rack out from scratch, we suggest clearing the rack area of cluttered and tangled network cables, which will improve airflow and reduce cooling costs

3. Secure your IT equipment from unauthorized access and unexpected incidents.

Whether it's an unwanted visitor or other impeding equipment, make sure your IT equipment is secure. Enclosures are beneficial to keep out unauthorized personnel. Additionally, depending on your geographic location, you may need to consider accessories such as anchor kits, which can prevent accidents by securing equipment in place in seismically designated locations.

4. Consider presentation.

Is it a customer-facing location? Presentation should be considered regardless, but aesthetics may play a bigger role if you plan to showcase your server room, network closet or data center to customers. You will want cables to be organized, equipment secure, and the surrounding area to be clean and neat. The perception of your customer, your boss or other non-technical people as to how seriously you're handling their data is crucially important.

5. Document everything.

Label. Diagram. Photograph. These are tactics you should become very familiar with in the planning and deployment phase of your project. Date the files, but continue to update as you maintain the space. Make sure you have serial numbers, warranty information, product detail, and product roles documented with corresponding pictures saved in digital and hard copy formats. Hard copy diagrams can be posted close by to ease troubleshooting.

6. Minimize downtime.

Removing old equipment is one of the riskiest steps. Downtime is expensive, so it's important not to do anything that would risk it during regular operating hours. Do as much as you can during the day, but try to switch over to the new equipment after hours.

The next time you walk into your network closet or are tasked with building out a new installation, consider organization, protection, and management and focus on the steps that make the most sense for you.

Solution worksheet

You should now have a clearer view of the type of solution you are interested in, and perhaps be one step closer to making your final decision. When the time comes, be prepared to get more technical. Keep this worksheet handy for any vendor discussions so your ideal rack or enclosure solution can be configured to your specific requirements.

Features	Requirements
Size: The most important attribute is how much rackmount space is required. The most common size is 42U (each U is 1.75" and equipment is generally in multiples of U). Next is the width and the most common are 24" (or 600 mm) and 30" (800 mm). The depth is generally 34" and deeper with 42" being the most common.	Height (U): Width (24"/30"): Depth (in.):
Weight loading: An estimate of the anticipated weight loading is key and loading can vary widely depending on the application. A networking application is generally under 2,000 lb. A high-end switch configuration is between 1,500 and 3,000 lb.	Weight loading (lb.):
Casters/levelers/anchorage: Are casters required? Generally, all enclosures come with levelers regardless of whether there are casters or not. Will the enclosure be anchored to the floor? Is an anti-tip feature required?	Casters: Yes / No Anchor brackets: Yes / No Anti-tip: Yes / No
End-of-row or bayed: Is the cabinet standalone (i.e., requires side covers), end of row (side cover on one end), or bayed with adjacent cabinets (no side covers)? If bayed, do you need a divider panel between adjacent enclosures for airflow management and/or security? In a typical installation, you may have some of each of these configurations.	End or row: Yes / No Qty: Bayed: Yes / No Qty: If bayed, dividers? Yes / No Qty: Standalone: Yes / No

Features	Requirements
Seismic: Does this enclosure require a NEBS GR-63-Core seismic test certification? (Note: This is different from seismic anchorage. The weight loading in these applications is generally between 800 and 1,300 lb.)	Seismic: Yes / No
Front doors and locks: Do you need solid or perforated front doors? Full or split front doors? Full is most common on front doors.	Solid or perforated? Full or split? Lock type (key / combo / HFID):
Rear doors and locks: Do you need solid or perforated rear doors? Full or split front doors. Split is most common on rear doors.	Solid or perforated? Full or split? Lock type (key / combo / HFID):
Top covers: Any special features required on top cover? Brushes to ensure hot air is contained in the enclosure? Networking cable cutouts for large quantities of cables? Troughs on top to manage cabling on the top of the enclosure?	Top cover requirements? Cable egress / brushes / networking cable cutouts / troughs
Rails: Rails are generally available in two configurations: square holes for use with cage nuts or tapped holes for direct mounting. Square holes are the most common. If a 30" wide enclosure is selected, please specify if 19" or 23" mounting is needed.	Square holes or tapped? For 30" wide: 19" or 23" mounting?

Airflow management

Features	Requirements
Hot aisle/cold aisle? Is the enclosure in a hot aisle/cold aisle installation? If yes, it's important to make sure the area in front of the rails is closed off from the hot zone. Gasketing options will be recommended.	Hot aisle/cold aisle installation? Yes / No
Blanking panels: One of the most important accessories for airflow management is blanking panels, which are used to close up unused U spaces. Specify the number of anticipated unused spaces.	Blanking panels: Yes / No Qty:
Floor grommets: Do you need access through the white space floor? Grommets allow cable egress/ingress but retain hot/cold aisle separation.	Floor grommets: Yes / No
Chimney: If hot air is to be ducted to an overhead plenum, a chimney is required unless the enclosure is in a hot aisle configuration. Chimneys can solve thermal issues on isolated enclosures. If a chimney is used, the rear door must be solid.	Chimney required: Yes / No Any special installation concerns (e.g., low ceiling, overhead cabling)

Power

Features	Requirements
Rack PDUs: Specify the quantity and type of rack PDUs needed to power the enclosure. Eaton has an extensive offering of rackmount power distribution solutions. Eaton's options can be researched at Eaton.com/epdu.	Specify power distribution requirements:
UPS: Is power backup needed? Rackmount? Power and duration? For details on the range of UPSs compatible with data center enclosures, visit Eaton.com/UPS.	Specify power backup requirements:
Management/monitoring: Is power monitoring/management required? Temperature/ environmental monitoring?	Specify management/monitoring needs:

Cable management

Features	Requirements
Front: What type of cabling is expected? If low levels of cabling, then cable rings or a lacing bar with Velcro straps is a good solution. For high levels of cabling or fiber, it's important to specify the quantity and type of cables. Based on requirements, we will suggest options such as horizontal managers, waterfalls, vertical cable managers, lacing bars, etc.	Describe number and type of cabling:
Rear: What type of cabling is expected? If low levels of cabling, then cable rings or a lacing bar with Velcro straps is a good solution. For high levels of cabling or fiber, it's important to specify the quantity and type of cables. Based on requirements, we will suggest options such as horizontal managers, waterfalls, vertical cable managers, lacing bars, etc.	Describe number and type of cabling:
Inter-cabinet cabling: Will there be cabling passing from cabinet to cabinet in the hot zone (i.e., behind the rails)?	Inter-cabinet cabling: Yes / No Qty: Type of cabling:
Cabling above the enclosure: Do you need cable management such as ladder racks or flextray (wire basket) cable management solutions above the rack?	Describe types of overhead cabling required:

Other considerations

Features	Requirements
Certifications/compliance requirements (e.g., UL, 2416; OSHPD)	Special requirements?
Special packaging needs: Reusable packaging? Heavy-duty packaging for shipping integrated enclosures? Crate?	Define any special packaging needs:

Frequently asked questions

1. **How is vertical rack space measured?**

   Rack space is measured by rack units (U). Ideally, the rack you choose will have U spaces numbered. One U is 1.75" and the most common rack height is 42U, made to fit 19" wide equipment. Measuring by vertical rack space allows you to plan by how much equipment the rack will hold.

2. **For a smaller server rack, what are my options?**

   Often a 42U enclosure—which is the most common—is not required. Smaller options such as 25U, 30U or 36U will provide more than enough rack mounting space for servers, UPSs, rack PDUs, switches and other equipment. The smaller options enable you to use the space on top for monitors or other equipment. Features such as perforated doors, adjustable rails, locks and casters are still available in these sizes. Wall mount enclosures can also be considered when a full-height rack or enclosure isn't necessary.

3. **Which matters more: internal or external dimensions of the rack?**

   Correctly sizing your rack is important to the security and performance of your servers and other equipment. Both internal and external size matter. The equipment that's housed within a rack needs to securely fit, and the rack itself needs to fit within doorways/elevators, etc.

4. **How much weight will a rack or enclosure hold?**

   It depends on the size of the rack, but there are solutions that can store up to 3,000 pounds of computer and networking equipment.

5. **Where in the room should I put my rack or enclosure?**

   A good rule of thumb is four feet of space, front and back, from the wall. Fire codes require three-foot walkways, but four feet will allow you to wheel a cart in the room safely and reduce human error overall. In the future, if you have equipment to install, you may need two people in the space at a time lifting, and you want enough space to comfortably get the work done. Otherwise, your rack location will be determined by your unique space. It needs to be in a place that has the appropriate electrical requirements and ample space to run corresponding data and power cables.

6. **How much space should go between racks or enclosures?**

   Ideally, your racks and enclosures should be side by side and can be bolted together. This is often called baying or ganging, and it allows you to maximize floor space and be more efficient while servicing the equipment stored in them. Remember, space is an invaluable resource in IT!

7. **How maneuverable does the rack need to be?**

   This will depend on your space and the type of rack you deploy. Enclosures often include casters for maneuverability, while two- and four-post racks are bolted to the ground.

8. **Does the rack need to be vendor-neutral?**

   No, but having a vendor-neutral rack will be more accommodating for most IT rooms. Technology is changing all the time and you don't want to feel pigeonholed into a certain brand of equipment. We recommend the rack you choose be able to accommodate all TIA/EIA 310-D equipment.

9. **What are the least expensive ways to organize cabling and equipment in my racks or enclosures?**

   Velcro straps for data and power cables and labels are the easiest and most affordable way to organize your racks, at a base level, and will likely have the biggest impact from an access and service standpoint.

10. **How do I know how many cables to account for within the rack?**

    Establish the number and type of cables within each rack. Count the number of servers and number of ports that will be utilized. Map cable destination points, too. The cable routing established now will impact day-to-day operation and equipment serviceability.

11. **Why shouldn't I run cables horizontally between racks and enclosures?**

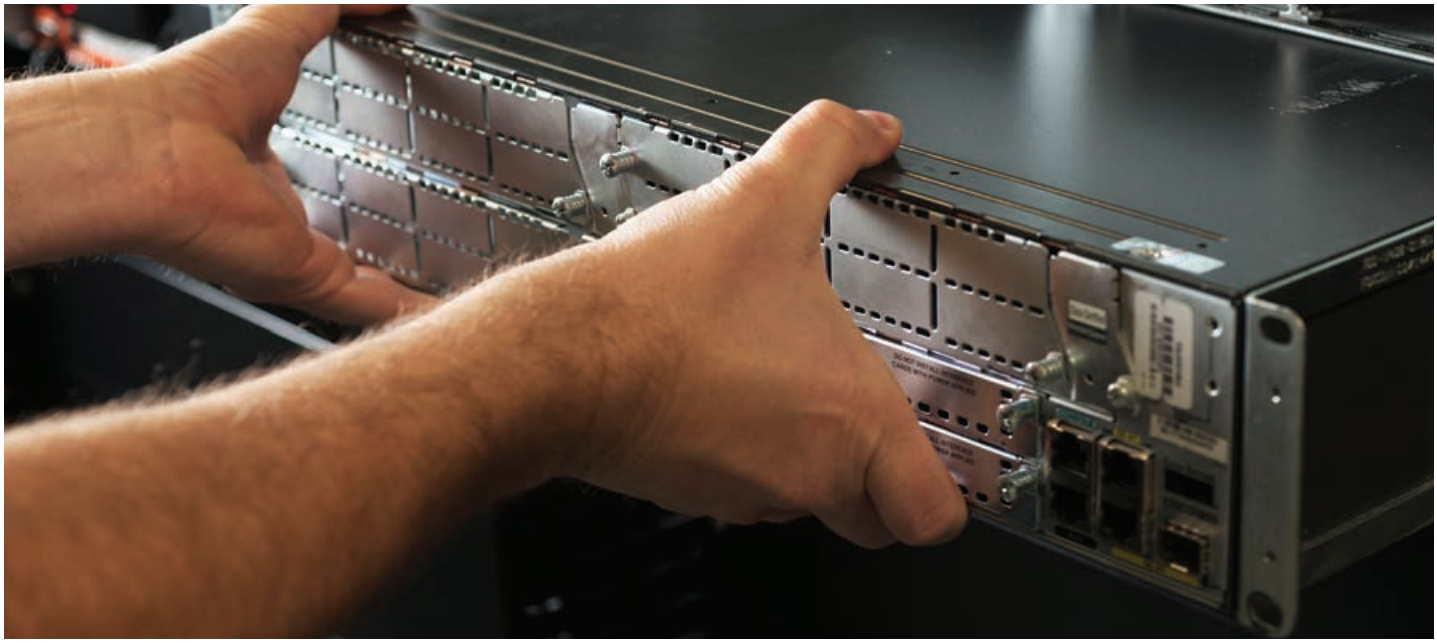
    You can run cables horizontally between racks, but you must ensure you're using the appropriate cable management devices to do so. If you simply run cables directly across—rather than up the side of the rack or enclosure to horizontal cable management devices—it will cause problems for you when you go to change out or service equipment as well as if you need to move a rack or enclosure.

12. **What are some of the most common mistakes end users make when choosing a rack or enclosure?**

    It's common that users don't factor in future growth, especially if facing budget restrictions. Even if there are no upgrades planned for the future, design the room as if there are. This is true for racks or enclosures as well. Consider a solution with a higher weight capacity if you need to add servers down the line. A good rule of thumb is to plan five years out with 20 percent growth rate per year.

    Another common issue is that users often do not consider ancillary equipment upfront. For example, be sure you have your power infrastructure mapped out and look at PDU mounting options.

Rack accessory glossary



While the terminology can vary from business to business, we tried to consolidate the most commonly used terms and provide definitions.

Bayed racks
Multiple racks of the same series, height and depth that are connected side by side. Also referred to as ganged.

Blanking panels
Steel or plastic plates that are inserted in empty U spaces at the front of a rack or enclosure. They are used to improve airflow for the installed equipment and to reduce hot and cold air recirculation and remixing within the rack. Also referred to as filler panels.

Brushes
Flexible brushes used in cutouts to create airtight entries for data and power cabling.

Busway
Provides flexible "plug and play" power distribution for a variety of applications where change and adaptation are important.

Cable egress
An opening or available space for exiting cables.

Cable ingress
An opening or available space for entering cables.

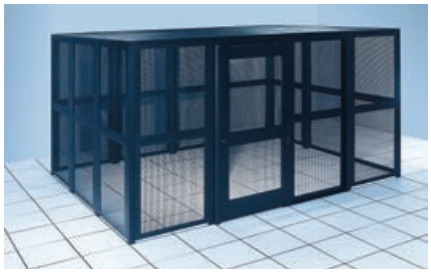
Cable managers
An easily installed device used to manage and protect cables either horizontally or vertically.

Vertical managers are available as single- or double-sided, and for the full height of the rack.

Cable pass-through blanking panel
Provides aesthetic appeal and controlled airflow management like solid blanking panels, but cables can pass through the flexible brush strip.

Cable tray
An overhead cable management solution that provides a support system for cables and raceways, guiding them from rack-to-rack and over aisles. Available in solid steel or wire basket.

Cages
Modular wall systems that can be used to partition white space environments, particularly in a colocation or multi-tenant data center (MTDC).

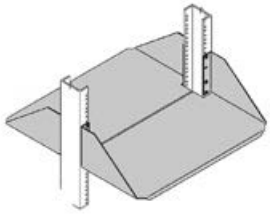


Casters
A wheel mounted to the bottom of a larger object (e.g., UPSs, racks or enclosures) to allow it to be moved in and out of place.

Chimney
A structure, usually vertical, containing a passage or flue by which hot air is extracted out of an enclosure.

Divider panel
A partition separating two racks or enclosures.

Double shelf
Used to store non-rackmount monitors, laptops and other equipment.



D-ring
Also referred to as a hook, this cable management accessory is a partially enclosed ring used to hold data and power cables. Open rings allow for easy access to cabling.

Environmental rack monitor (ERM)
This device continuously monitors environmental conditions at the rack level, providing an extra level of security for critical assets. It's most often found in high-density data centers and applications like healthcare, where the environment must be maintained within acceptable levels.

Finger bracket
Used to manage high-density cabling on the rack and between racks. Finger spacing should align with rack units. It's important that brackets comply with TIA/EIA-568-B.1/2/3 bend radius standards.

Flextray
A steel or wire mesh cable management system.

Floor anchor brackets
Used to securely fasten racks and enclosures to the floor.

Floor grommets
Used in raised floor cutouts to allow the entry and exit of cabling from subfloor plenums while allowing maximum pressure to be maintained in the data center's sub-floor when cables are installed.

Gasketing
The act of using a material (e.g., rubber) to make a joint or opening airtight.

High-density cable organizer
A cable management solution that provides integrated bend radius support for lateral transitions from switches to route cables front to rear.

Hinged cable managers
Creates easy cable access via:

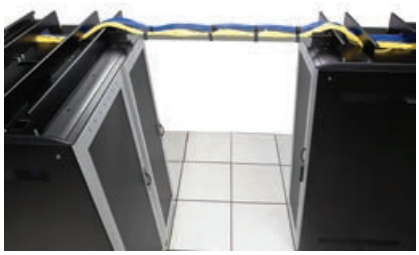
- Removable fingers for large cable bundle management
- Cutouts and screw holes that are compatible with cable management components
- Tool-less adjustment
- Velcro straps that can secure a cable bundle to the finger for strain relief

Horizontal lacing bars
Management bar that mounts to rails for attaching/mounting cables and power strips. The lacing bar is positioned vertically and doesn't take up valuable U space.

Ladder rack
Ladder-type cable runway for cabling pathways that mounts to ceilings, walls, floors, racks and enclosures.

Leveler
Adjustable feet that securely level the rack at the proper height.

Overhead cable management system
Overhead distribution of power and network cables to reduce raised floor obstructions.



Pass-through partition
An easily installed device used to manage and protect cables either horizontally or vertically.

PDU mounting brackets
Allow you to mount rack power distribution units upright within a rack.

Perforated
Holes typically on front and/or back rack doors that provide visibility and ventilation.

Power mounting bar
Allows you to mount power with keyhole mounting holes. Also see "rear lacing bar".

Rack PDU (or ePDU)
Rack PDUs distribute power to 4 to 45 receptacles in high-density rack environments. The plug-and-play architecture organizes power distribution, simplifies cable management, and lets you add and change IT equipment without an electrician.

Rack power module (RPM)
This device has customizable input and output configurations and voltages. It's meant to simplify data center power distribution by connecting directly from a three-phase UPS or other utility source to power secondary power distribution devices such as a rack PDU.

Rackmount UPS
A UPS ranging in size, weight and capabilities that can be installed within a rack.

Rail-mount cable managers
Equipment is often placed on a rail so it can be accessed without removing the wall of an enclosure or cabinet used in conjunction with Velcro buckles and straps and cable rings.

Rear lacing bars
Flexible management bar that mounts to the middle-rear of an enclosure or extension frame for cables and power strips.

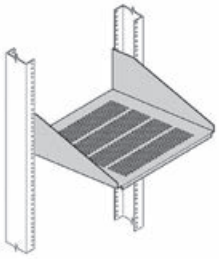
Seismic
Of or relating to earthquakes or other vibrations of the Earth and its crust.

Side panel

A panel on the side of the enclosure that can protect equipment from unauthorized entry.

Side cable chase
Provides a vertical plenum for management of network cables, power strips and power cords, routing them away from the back of equipment to optimize airflow.

Solid or vented she
Supports non-rackmount equipment within the rack.

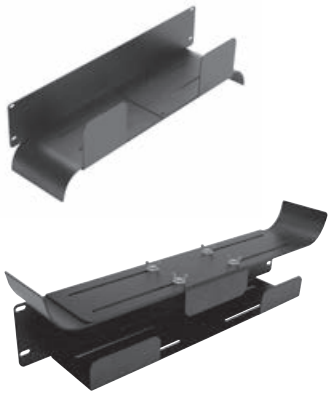


Spool
Provides a means to manage excess network or power cables with integrated bend radius support.

Strain relief bar
A bar that mounts to the back of a rack to support patch cables. Multiple depths are available to allow for transitioning of cables to different areas.

U space
One rack unit is 1.75" (44.45 mm) high. The size of a piece of rackmount equipment is frequently described as a number in U.

Upper or lower transition tray
Provides upper or lower bend radius control for copper and fiber cables. Important that the tray meets TIA/EIA 568-A bend radius standards.



Velcro buckle strap
Provides upper or lower bend radius control for copper and fiber cables. Important that the tray meets TIA/EIA 568-A bend radius standards.

Velcro buckle strap
Allows for mechanical fastening of straps to multiple points in the enclosure. Secures groups of cables into place and keeps racks organized.

Vertical lacing bars
Cabling can be secured using Velcro straps. Can typically be mounted side-by-side. Great for managing multiple large bundles of cabling.

Waterfall device
Provides a transition aid when routing fiber and patch cords into an enclosure. An ideal waterfall device will have integrated standard Velcro strap slots.

I LIKE THE SOUND OF A WATERFALL DEVICE.

Commonly used acronyms

UPS and electrical acronyms

AHJ	Authority Having Jurisdiction
ANSI	American National Standards Institute
CI	Converged Infrastructure
CRAC	Computer room air conditioning
CRAH	Computer room air handlers
ECIA	Electronic Components Industry Association
EIA	Electronic Industries Alliance
HCI	Hyperconverged Infrastructure
HFID	High Frequency Identification
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
kW	Kilowatt
MW	Megawatt
OSHPD	Office of Statewide Health Planning & Development
PDU	Power distribution unit
rH	Rack height
RU	Rack unit (also RMU)
TIA	Telecommunications Industry Association
TIA/EIA-568-B.	1/2/3 bend radius standards
UL	Underwriters Laboratories, a safety organization that sets standards and certifies manufactured equipment
UPS	Uninterruptible power system
VDV	Voice, data and video

Hyperconverged infrastructures seamlessly integrate network, server, storage and virtualization components. Integrated power management solutions like Eaton's provide the fifth element of CI and HCI solutions

U.S. seismic map

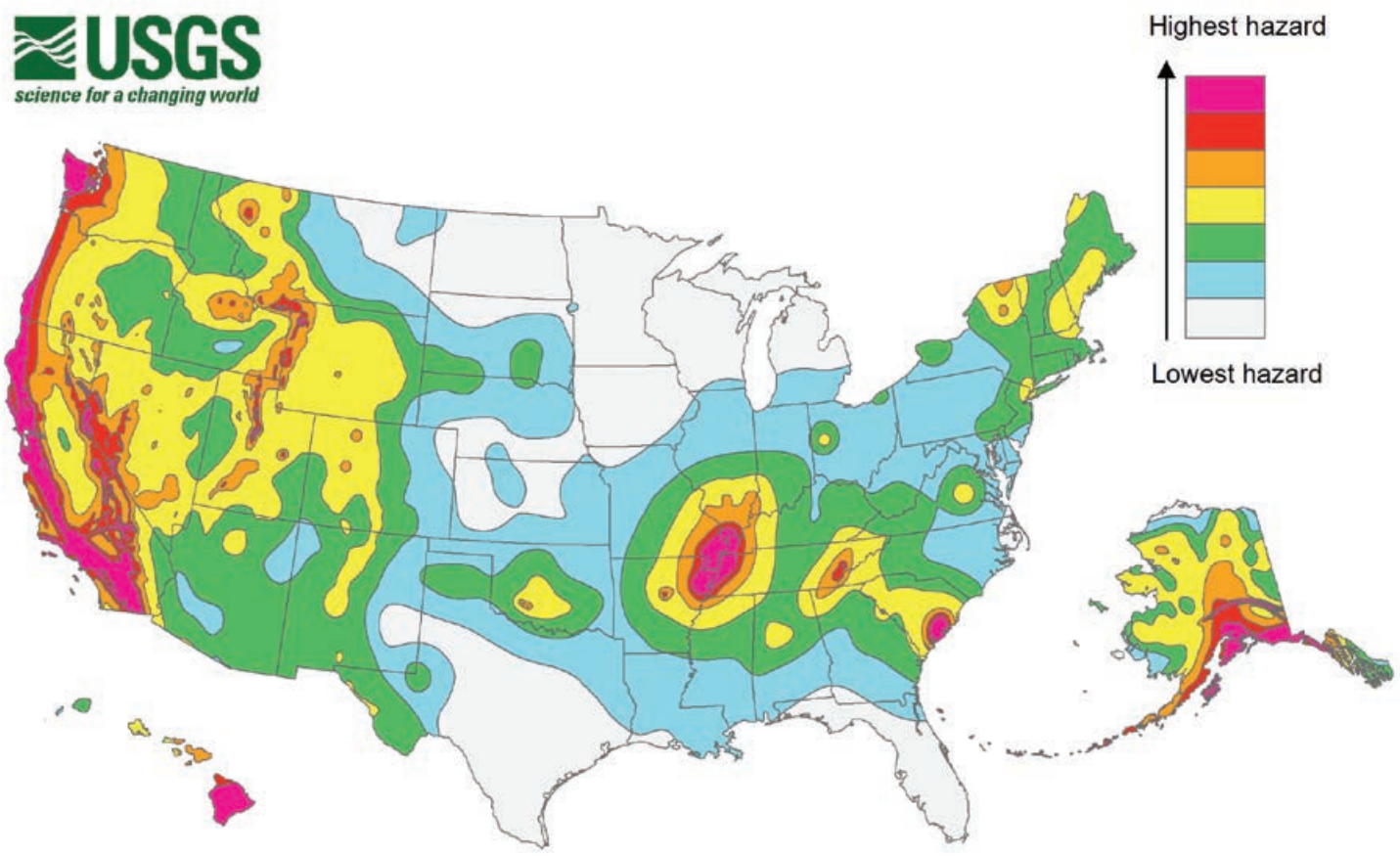
The United States Geological Survey's (USGS) Earthquake Hazards Program has put together maps and other resources to raise awareness, improve monitoring and reporting, and reduce risks related to Earthquakes.

According to their website:

- Earthquakes pose significant risk to 75 million Americans in 39 states
- Several million earthquakes are estimated to occur in the world each year
- Many go undetected because they occur in remote areas or have very small magnitudes
- The USGS now locates about 50 earthquakes each day; 20,000 a year

For data center design and everyday IT operation, it is important to consider earthquakes and the other environmental hazards that could damage equipment and threaten data security and business continuity.

According to USGS, this is a simplified hazard map of 2014.



Find maps and more resources at earthquake.usgs.gov/hazards

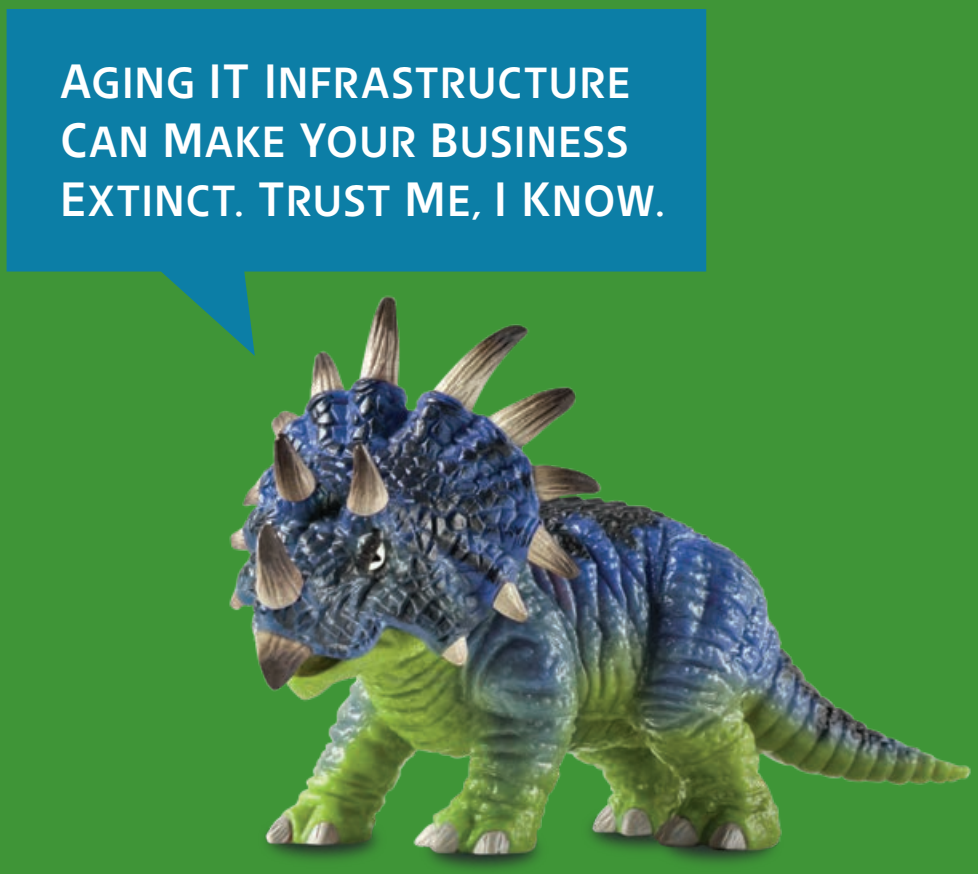
Free site evaluation

When it comes to IT equipment and network closets, Eaton and our resellers are experts.

Call us today for a free site evaluation. We'll provide everything you need to organize, protect and manage your IT equipment.

Contact 877.423.0065.

While you're at it, check out the Eaton's Site Assessment tool at **Powerquality.eaton.com/assessmenttool**



THIS WAS INFORMATION I COULD REALLY SINK MY TEETH INTO.

Know racks and enclosures like the back of your hand?

Test your knowledge HERE!

For more information, please visit **Eaton.com/racks**

Powering Business Worldwide

Eaton
1000 Eaton Boulevard
Cleveland, OH 44122
United States
Eaton.com

MZ159003EN / GG
January 2019

Follow us on social media to get the latest product and support information.