Brochure

Quick guide to power distribution

Bring peace to your IT environment

January 2017

Powering Business Worldwide

Switch ON to Eaton.

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Introduction

Rack power distribution units, also known as rack PDUs, are a key component to any IT environment. They do exactly as the name suggests and distribute power to network equipment within racks. A common misconception is that they're *just* power strips, and at first glance, they even look like it, but modern rack PDUs provide benefits a simple power strip cannot. Some of the valuable features include network connectivity, environmental monitoring and remote access, but we'll get more into that later.

This guide should help you get familiar with power distribution, gain interesting insights and learn some key considerations for future IT investments.

Power distribution from network closets to data centers

What is power distribution?

Power distribution is facilitated through different pieces of equipment that take the power conditioned by your uninterruptible power supply (UPS) and send it to your IT equipment. Power distribution solutions can manage and even control energy consumption in smaller environments as well as large data center applications. Distributing power efficiently results in reduced operating costs and increased reliability.

This diagram is a simple representation of how power flows in an IT environment:

In a larger data center environment, the power infrastructure will typically have more elements, and may flow like seen in this diagram:

Types of power distribution

Whether you need integrated power distribution within a few racks or power throughout your data center, there are many solutions to consider when building out your power infrastructure. Understanding your environment and power needs allows you to begin right-sizing your distribution equipment.

Out of all the equipment listed on the next page, rack PDUs are the most common in IT environments (big or small). We will spend the remainder of this guide digging deeper into rack PDUs and their value, but first let's introduce different types of power distribution.

Rack-based

Floor-based

Rack-based versus floor-based

A

B

C D E F

G

A

Rack-based

A **Rack PDUs** are used to effectively distribute power in rack environments with multiple outlets and a range of intelligent features to help control the power distributed to IT devices. Rack PDUs are used in all environment sizes and come in a variety of plug and outlet configurations, including 120 and 200-240 volts. Whether it's the only distribution unit or part of a whole distribution strategy, it's a vital connection point and allows you to protect your entire IT investment.

Which type of rack PDU is right for you? Go to page 8 to find out.

B **Rack automatic transfer switches (ATS)** are designed for switching non-phase synchronized AC power sources. They provide automatic transfers from a primary to secondary source to power critical equipment without interruption. Rack ATSs are most commonly seen in network closets and server rooms.

Floor-based

C **Power distribution racks (PDR)** are typically seen in larger high-density data center environments. A power distribution rack provides space-saving power distribution in a flexible design. These racks can offer 168 circuits and accommodate more servers with multiple power cords and rack PDUs with growing loads.

D **Power distribution cabinets of large PDUs** are often seen in large data centers for raised and non-raised floor applications to take incoming power and distribute it to an individual rack or groups of racks. Distribution capacity can range from 84 to 252 circuit breaker pole positions. A PDU can optimize utilization and availability down to the branch circuit level as well as address specific needs for isolation, voltage transformation, harmonic reduction, and voltage regulations. Floor-based PDUs should have monitoring capabilities as well.

E **Remote power panels (RPPs)** facilitate power distribution with up to 168 factory-installed branch breaker in a highly compact footprint and has extensive monitoring options. They allow for electrical expansion without the need of costly electrical rework, feeding the RPP distribution module from the existing transformer or panelboard.

F **Static transfer switches (STS)** are high-speed devices that can transfer electrical loads from one AC power source to another in a fraction of a single electrical cycle. The STS eliminates the chance of a loss of power to critical loads by properly coordinating with the electrical distribution system. During a fault condition, the STS continues to conduct current, allowing downstream circuit breakers to work selectively.

Other

G **Busways** are most often seen in high-density data center applications providing flexible overhead power distribution where change and adaptation are important. Busways don't take up any floor space and allow flexibility in data center design and scalability.

Rack PDU installation options

How will you be installing your rack PDU? While seemingly minor, mapping out how you will set up your rack space before buying the equipment will be a time- and cost-saving activity.

Vertical mount

Vertically mounted PDUs have up to 60 outlets and are installed in the back of the rack in the 0U rail space. The form factor can be tailored to fit most rack heights and can help free up valuable U space being mounted in the rear of the rack. Vertically mounted PDUs free up your rack space when in the back of the rack. Mounting your PDU can potentially take time, so you should think about how you want to install it and what tools will be required. You may have the option for tool-less installation, which is a great feature that's possible in compatible racks.

Here is an example of two PDUs vertically mounted in the 0U rail space of a compatible rack with tool-less installation.

Horizontal mount

Horizontally mounted PDUs are installed within the rack U space and sit horizontally in line with your IT equipment. These typically use 1U or 2U of rack space and typically have 8 to 16 outlets.

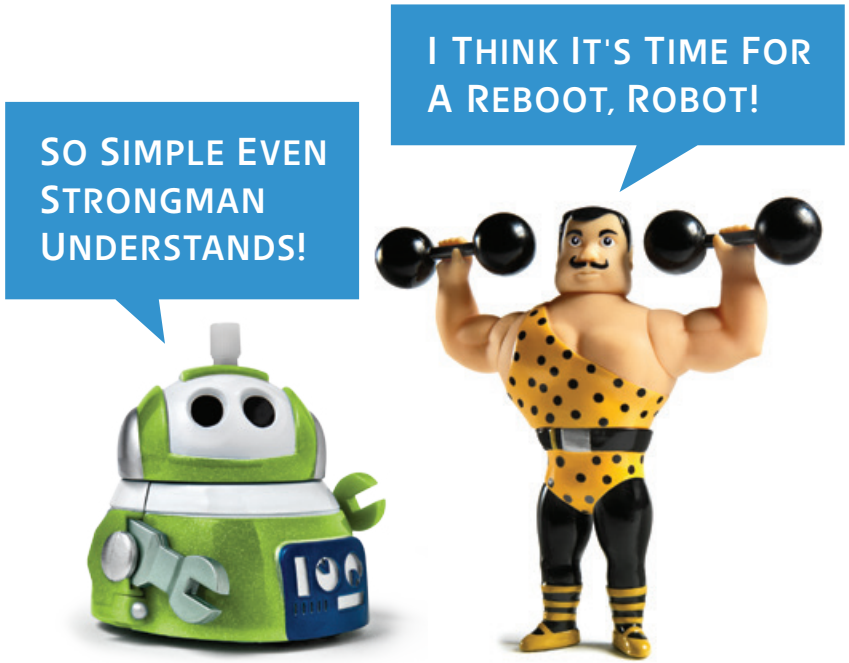
Here is an example of a horizontally-mounted 1U PDU.

Friendly tip!

Plug direction

Consider how you will be accessing your PDU.

Where do you need the plugs to face? If you need to replace the meter on the PDU, will you be able to?



Tour a rack PDU

Discover the many rack PDU features and benefits available in modern units. On the right is an Eaton ePDU G3 Managed model with call-outs for key features.

You can also see the feature and benefit definitions on the following page.

Outlet switching

Remotely control devices by powering on or off individual outlets. Save time and operating costs by rebooting machines from your control center without costly site visits.

Turn off unused outlets

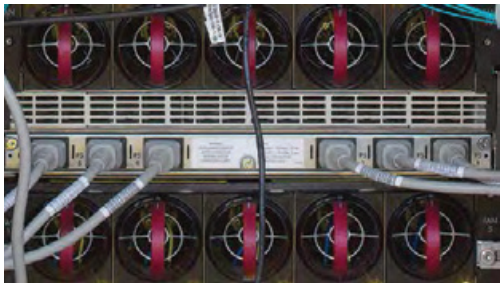
Secure and protect your environment by easily turning off unused outlets. Avoid overloading your system from others plugging in unauthorized devices. Also consider closing access with an outlet cap.

Green LED signifies power on and red is power off to outlet

Cap secures in place with cable tie

Grouped reboot for A and B feed

When connecting multiple source input servers to an A and B feed power source, the daisy-chain capability allows you to group power supplies across the ePDU. As a result, all the power supplies are controlled with a single action, which saves time rebooting servers with two to six power supplies.



Typical server with multiple power inputs powered by two ePDUs

Color-coded outlet sections

Color-coded outlet sections match a corresponding circuit breaker to easily identify which one feeds corresponding outlets and prevent unbalanced loading that would unnecessarily trip a breaker.

O is unlocked, + is grip engaged

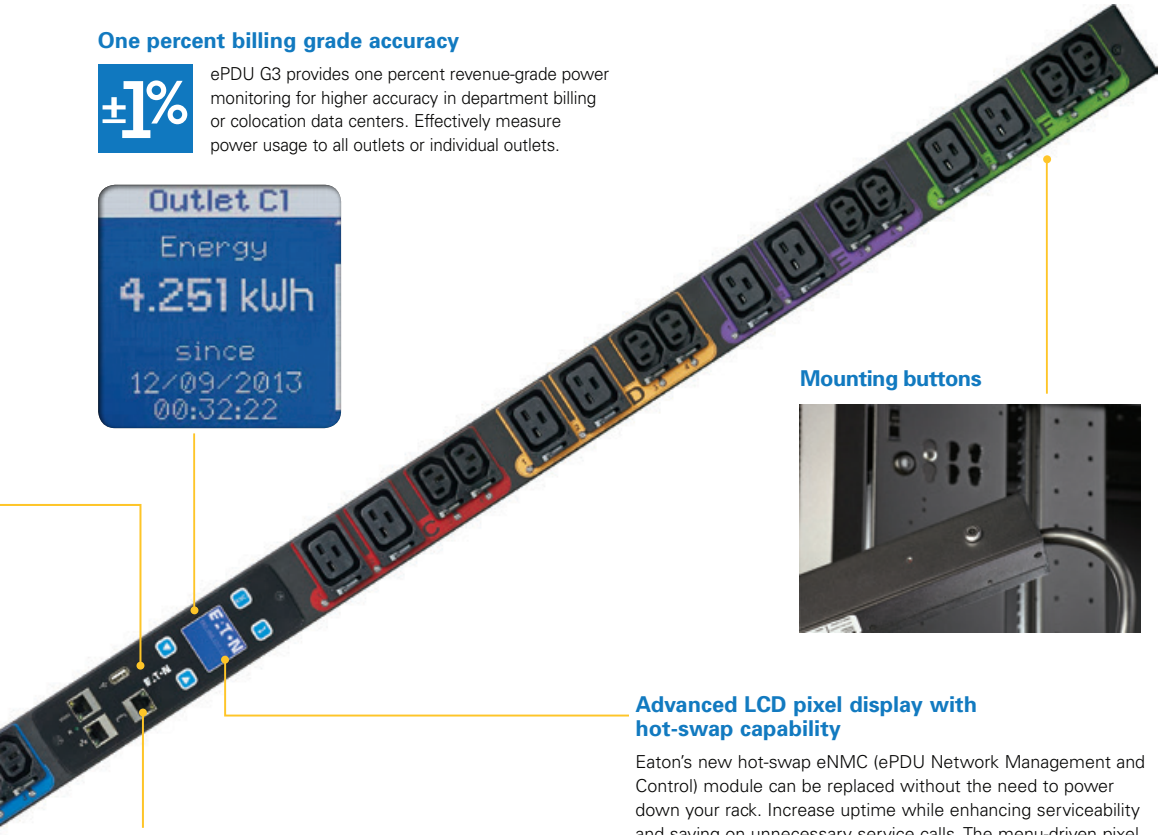
Outlet grip functionality

Eaton's patent-pending IEC outlet grip secures plugs in place with a lever-actuated grip that's integrated into each outlet. Once the levers click into the grip position, the plugs are secured from accidental disconnect due to bumps or vibrations without the need for special power cords.

One percent billing grade accuracy

±1%

ePDU G3 provides one percent revenue-grade power monitoring for higher accuracy in department billing or colocation data centers. Effectively measure power usage to all outlets or individual outlets.



Mounting buttons

Advanced LCD pixel display with hot-swap capability

Eaton's new hot-swap eNMC (ePDU Network Management and Control) module can be replaced without the need to power down your rack. Increase uptime while enhancing serviceability and saving on unnecessary service calls. The menu-driven pixel display allows for easy setup and troubleshooting.

Module being removed without removing power to the ePDU

Daisy chain eight units from one IP address

Eaton's new patented daisy-chain capability allows up to eight ePDUs to share the same network connection and IP address. Unlike competitive rack PDUs that require a dedicated IP address for best performance, Eaton technology provides a 87.5 percent reduction in network infrastructure costs.

A and B power PDU sharing a network connection via daisy chain

Features and benefits

Remote site management: Save time from onsite visits
High 140°F (60°C) operating temperature: Fully functional in high operating temperature environments, resulting in reduced cooling costs
Group reboot for A and B feed: Group multiple power supplies across the rack PDU to control all with a single action, saving time when rebooting servers with two or more power supplies
One percent billing grade accuracy: Revenue-grade power monitoring for higher accuracy to help optimize power utilization
Turn off unused outlets: Control unauthorized use
Low-profile form factor: Provide zero interference into the rail space
Hot-swap meter: Remove meter without power disruption to increase uptime while enhancing serviceability
Measure power consumption at outlet level: Acquire precise data and gain detailed energy analysis to make informed decisions and assist with effectively deploying equipment
Outlet switching: Remotely control devices by powering on, off or rebooting individual outlets
Integrated IEC outlet grips: Integrated lever-actuated grip that easily secures plugs to prevent accidental disconnect
Measure Level 3 PUE: Measuring power at the outlet level allows users to measure Level 3 Power Usage Effectiveness (PUE), which provides the possibility of transforming billing into revenue or utility discounts
Color-coded outlet sections: Color-coded outlet sections match corresponding color-coded circuit breakers to simplify load balancing
Phase and section metering: Meter color-coded sections to control power utilization
Advanced LCD pixel display: Allow for easy IP setup and troubleshooting
Daisy chain (share network connection/IP address): Share the same network connection and IP address for up to eight rack PDUs, which will reduce network infrastructure costs
Ease of installation: Lightweight design and pre-installed, tool-less mounting buttons make the installation process quick, easy and flexible for most environments

Which PDU is right for you?

Power distribution is needed in racks to properly connect servers, switches and other IT equipment, but beyond that, you must find out which type is best for your needs. Consider the application you are buying for to help determine which PDU model is right for you.

Basic model

Basic models, while lightyears ahead of legacy PDU products, are still only equipped with the primary features necessary to distribute electrical power and "get the job done."

Metered model

Metered models have varied measurement functionalities and service enhancements that let you save time and money.

Managed model

Managed models give you the most advanced power management and precision control that can empower your decision-making and eliminate the most risk.

How to select a PDU by application type

Application	What to look for
Small/medium business	• Portfolio of 120V and lower power ratings (kVA) • Economical basic or metered input models • Advanced LCD pixel display for local monitoring
Remote office/ branch office	• Portfolio of 120V and lower power ratings (kVA) • Reboot devices without local IT staff assistance • Control unused outlets to prevent unauthorized use • LCD pixel menu display simplifies setup
Enterprise data center	• Up to 208V three phase 17 kW for high density applications • Network monitoring of power usage and capacity at the outlet level • Save time by rebooting devices from the operations center • Measure for Level 3 power usage effectiveness (PUE)
Colocation service provider	• Simplify load balancing with color-coded outlet sections • Control unused outlets to prevent unauthorized use • Measure for Level 3 PUE • Measure tenant power consumption to the outlet level for accurate billing to this degree of accuracy

PDUs have a wide range of features and benefits. To find out which features will be the most valuable to you, you can start at the business need and consider PDUs that were built to address your particular challenges.

For help selecting the right PDU, visit switchon.eaton.com/power101 for a lesson from Professor Wattson.

How to select a PDU by business need

Need	How
I want to: • Effectively distribute electrical power • Organize my power distribution strategy • Simplify load balancing • Prevent accidental plug disconnects • Reduce cooling costs and maintain full functionality in high temperatures	**Basic PDU** **Look for a unit with features like outlet grip plug retention, color-coded outlet sections, a low-profile form factor and high operating temperature capabilities.**
Yes, I want all that, but I also need to save time with the ability to: • Optimize power usage with highly accurate power monitoring • Use meter color-coded sections to control power utilization • Remove meters to make service pain-free and maintain uptime • Have easy access to information, IP setup and troubleshooting • Share network connection/IP address for multiple PDUs	**Metered input rack PDU** **Look for a unit with features like one percent billing grade accuracy, LCD pixel display, daisy chain capabilities, hot-swap meter, and phase and section metering.**
Yes, I want all that, but I also need to save money with the ability to: • Make better deployment decisions with precise data and energy analysis through outlet-level measurements • Transform billing into revenue or utility discounts by measuring Level 3 PUE*	**Metered output rack PDU** **Look for a unit with features like measurement capabilities at the outlet-level.**
Yes, I want all that, but I also need to reduce risk with the ability to: • Remotely controlling devices by powering on, off or rebooting individual outlets • Control unauthorized use of unused outlets • Avoid onsite visits with remote capabilities • Group multiple power supplies across the PDU to control all with a single action (i.e., save time when rebooting servers with two or more power supplies)	**Managed PDU** **Or look for a unit with features like outlet switching, turning off unused outlets, remote site management and group reboot for A/B feeds.**

What is ITs favorite PDU feature?

With more than 167 survey submissions in March 2016, we found IT's most beloved rack PDU feature.

Corresponding with the annual NCAA basketball tournament, we pitted 16 of the sweetest features against each other and left the voting exclusively to the **Spiceworks community**. Throughout all the match-ups, it seems features that save users time always reigned supreme. One IT participant commented:

"I enjoy anything that will make my daily tasks more simple."

The championship came down to two features with remote capabilities:

Outlet switching *vs* remote site management

vs

Winning feature:

Remote site management is the winner!

Remote site management was the clear winning feature, but go to page 10 to see exactly how the tournament played out.

See what fun things we are up to in the Spiceworks community by joining and following us at Spiceworks.com/Eaton

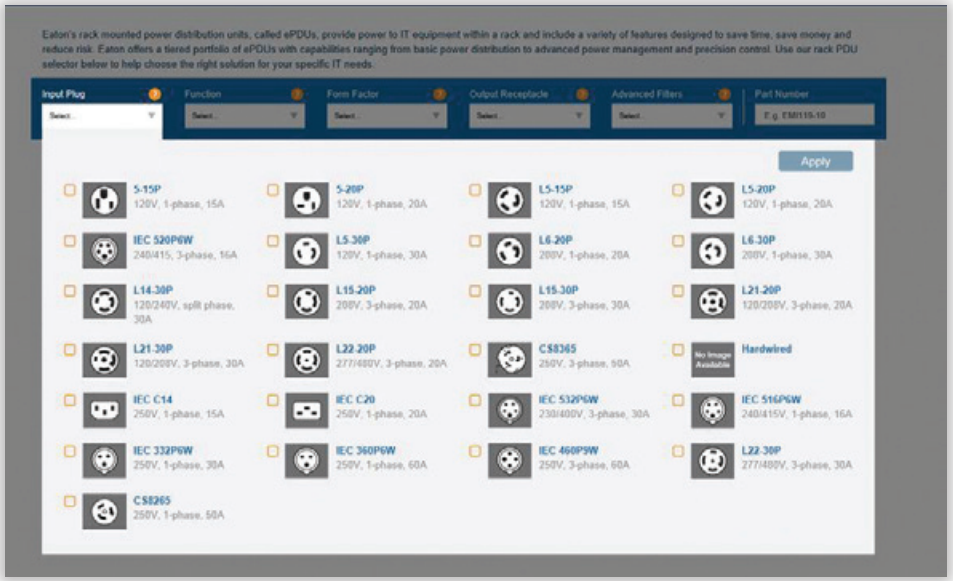
Battle of the best rack PDU features

What matters most to you?

Sixteen of the sweetest features battled it out to be named IT's favorite feature.
This is how the Spiceworks bracket unfolded.

Questions to consider when choosing a PDU

Before talking to a manufacturer or reseller, review these questions so you are prepared for the type of decisions you may need to make when evaluating a PDU.



1. **What input plug and output receptacles do you need? See the images to the left to get an idea of your options, and go to Eaton.com/RackPDUselector for more details.**
   - Input plug (which type of outlet will you plug the rack PDU into)
   - Output receptacle (what will you be plugging into the rack PDU)
2. **How many different outlets do you need?**
3. **What kW power range will you require?**
   a. 0-5 kW – Standard density
   b. 5-10 kW – High density
   c. 10+ – Ultra high density
4. **Where will you be installing the PDU?** If applicable, what size rack will you be installing the PDU and will it be horizontally or vertically mounted?
   a. OU (Vertically mounted)
   b. 1U (Horizontally mounted)
   c. 1U and 2U (Horizontally mounted)
5. **What functionality do you need?**
   a. Basic – distribute power among your equipment
   b. Metered input – includes a LCD display, easy serviceability and advanced measurement capabilities
   c. Metered outlet – allows you to monitor at the outlet level
   d. Managed – includes remote monitoring and management capabilities to the outlet level
   e. Hotswap – enhances availability by facilitating UPS replacement without shutting down connected equipment
   f. Remote emergency power off – immediate and complete power off control from one button
   g. Automatic transfer switch – Transfers power from primary to secondary source for power redundancy to equipment with a single power supply

Additional considerations to help you choose a rack PDU:

- Do you want the ability to daisy chain? How many units?
- Do you want to secure plugs with integrated IEC outlet grips?
- Do you want environmental monitoring capabilities?
- What input cord length will you require?
- Do you need circuit breakers?
- Do you need the unit to be TAA compliant?

From, input plugs to form factors and measurement features, Eaton's Rack PDU selector tool can help you find the right solution for your specific IT needs.

The history of rack PDUs

Before rack PDUs had the capabilities they do today, people often wondered what to do with them. Even IT pros found alternative uses for the basic power strips by using them as pretend light sabers or the occasional hiking stick. Only kidding, of course. But here, are some light-hearted but true facts on the evolution of the PDU as is related to other technology in pop culture.

In 1988 . . .

The same year the first PDU patent was filed, the first online virus infected computers across the country. According to its creator, the virus was not written to cause damage, but to gauge the size of the Internet.

In 1993 . . .

When Pulizzi (now Eaton) first launched the patented PDU at WESCON tradeshow, IT pros may have been distracted by the launch of a literal game-changer: id Software's massively popular first-person shooter game Doom.

In 2000 . . .

When Pulizzi introduced remote reboot capabilities for PDUs, it helped IT pros save time and money by preventing costly site visits. Around the same time, USB drives helped IT pros save space by ditching their floppy discs.

In 2001 . . .

When the vertical PDU was introduced, IT pros could more effectively organize their infrastructure by mounting it at the back of the rack. After this, they could then visit the very first Apple stores in McLean, Virginia, and Glendale, California.

In 2011 . . .

For the first time, new LCD displays on Eaton's rack PDUs made it easy to color-code outlets. Apple's voice-activated personal assistant Siri made it easier to get directions, check scores and predict the weather.

In 2014 . . .

Eaton introduced a patent-pending grip outlet for its rack PDU to hold standard plugs in place. In web history, 2014 will forever be known as the year HTML 5 was introduced, replacing the standard HTML 4 that had been in place since 1997.

Fun fact!

PDU throne

PDUs can help you be the ruler of your IT realm.

Eaton has been in the PDU business for some time, and recently put left over and obsolete PDUs to some creative use. We teamed up with a local Raleigh, NC artist to create this PDU throne as a shout out to one of our (and IT's) favorite shows.

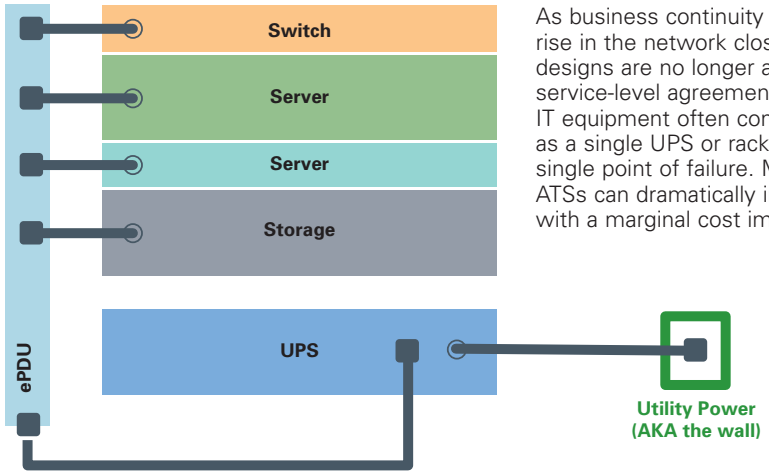
EVOLVE OR DIE!

Typical PDU configurations

Recommendations for improved reliability

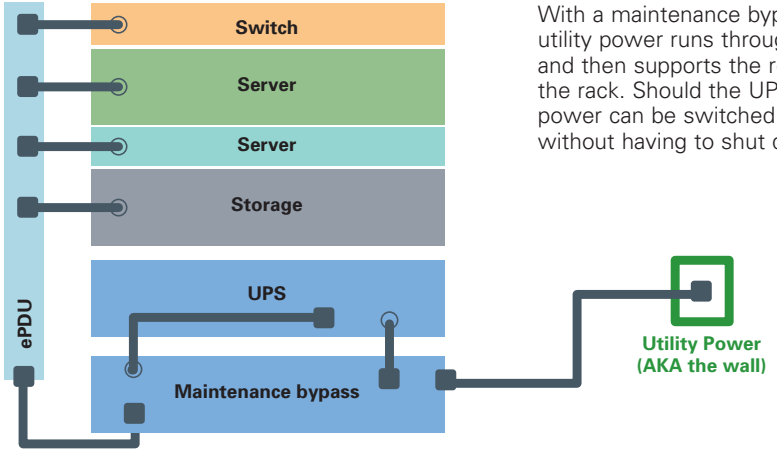
In traditional power designs, you may have one UPS supporting your servers, switches and storage devices. In this type of environment, you are prone to having to shut down your equipment during a power failure, UPS maintenance or UPS replacement.

Traditional installation



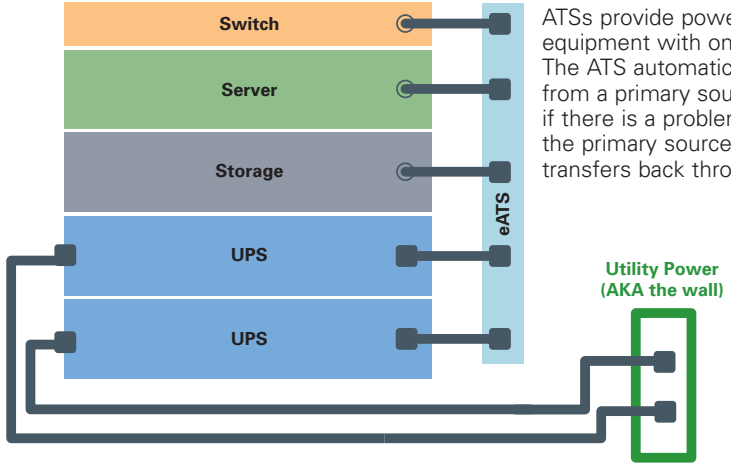
As business continuity requirements continue to rise in the network closet, traditional power designs are no longer adequate to meet IT service-level agreements. However, single-corded IT equipment often complicates system design, as a single UPS or rack PDU may represent a single point of failure. Maintenance bypass or ATSs can dramatically improve system reliability with a marginal cost impact.

Maintenance bypass



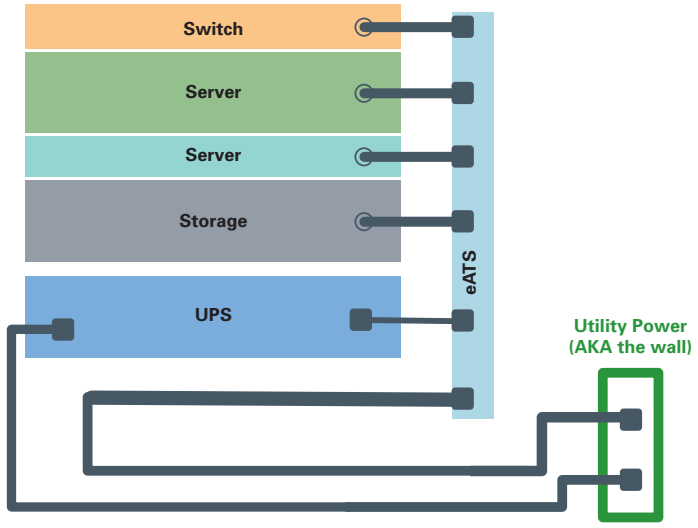
With a maintenance bypass (MBP) for example, utility power runs through the MBP via the UPS and then supports the rest of the equipment in the rack. Should the UPS need to be replaced, the power can be switched away from the UPS without having to shut down your equipment.

Dual feed, dual UPS



ATSs provide power redundancy to equipment with only one power supply. The ATS automatically transfers the power from a primary source to a secondary source if there is a problem with the primary. Once the primary source is restored, power transfers back through it.

Dual feed, single UPS



Eaton eATS models:

1. **Graphical LCD (available on the 15- and 20-amp models) signifies which source is being output (30-amp models have a static display for identifying the source)**
2. **Test button can be used to manually force transfer**
3. **Network card supports IPv6 and provides remote monitoring capabilities via web browser or SNMP**

Remotely monitor alerts, provide redundant power and keep mission critical applications running with this reliable and easy-to-use solution. Learn more at eaton.com/eATS.

NICE SOLUTIONS, BUT I BELIEVE BACON CURES EVERYTHING!

Power planning for non-traditional environments

Are you managing a converged or hyperconverged infrastructure with non-traditional or condensed network elements?

Even if you are not deploying a traditional rack configuration, there are still validated power infrastructure designs you should consider in condensed converged and hyperconverged infrastructures.

Converged and hyper-converged infrastructures operate with fewer components, which means backup power and environmental monitoring, management and control related to power is much more vital.

Rack PDUs are an important element to power planning in these integrated environments. Follow the plans below to properly plan your environment.

Power planning

- **Gather basic information** about the site where the hyperconverged solution will reside
- **Answer these questions** to confirm UPS and PDU selection:
  - > **What voltage is used?**
  - > **Is power available as a single- or three-phase source?**
  - > **What types of power input plugs are used?**
- **For dual power supplies in small deployments:** connect the nodes and switches to one PDU and then to the UPS for power protection.
- **For larger deployments:** use two rack PDUs for redundancy. Plug each rack PDU into a different load segment (group of receptacles that can be independently controlled) of the UPS.

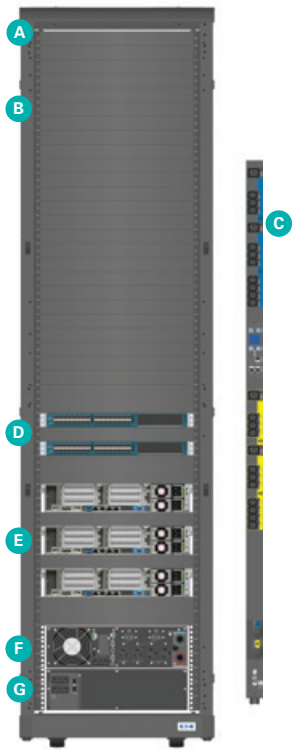
Eaton, as an example, provides configuration recommendations and validated reference designs with key partners to deliver significant value when power planning and implementing.

The main players in the space have chosen to partner with power management providers to develop integrated solutions and product lab-validated designs.

To see how Eaton equipment works with converged and hyperconverged solutions, visit:

Eaton.com/Cisco
Eaton.com/EMC
Eaton.com/NetApp
Eaton.com/Nutanix
Eaton.com/Simplivity
Eaton.com/VMware
Eaton.com/VCE

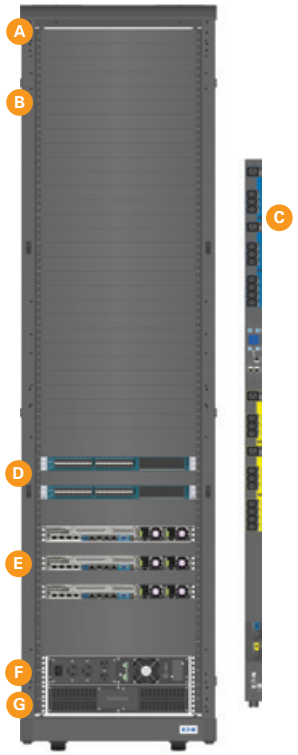
Sample reference designs:



Rear view

Small footprint using HX220c M4 nodes (3-node minimum)

- A Eaton 42U enclosure
- B Eaton blanking panels
- C Cisco UCS 6248UP 48-port fabric interconnect
- D Cisco HX 220c M4
- E Eaton 9130 rackmount, 2700 Watt, 2U UPS
- F Eaton external battery module for 9130 UPS, 2U

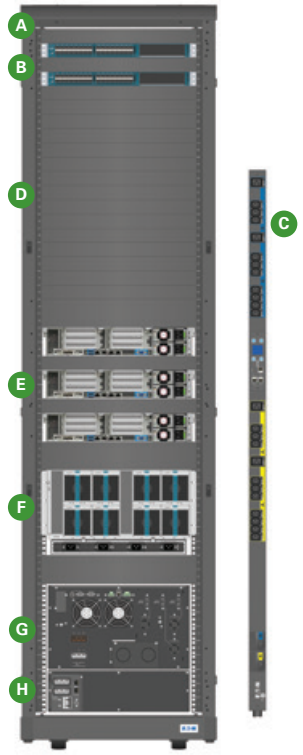


Rear view

Capacity-intensive cluster using HX240c M4 nodes (3-node minimum)

- A Eaton 42U enclosure
- B Eaton blanking panels
- C Eaton managed ePDU G3
- D Cisco UCS 6248UP 48-port fabric interconnect4
- E Cisco HX 240c M4

  Eaton 9PX, 4500 Watt, 3U UPS
- F Eaton external battery module for 9130 UPS, 2U



Rear view

Compute-intensive hybrid cluster using HX240c M4 nodes (3-node minimum)

- A Eaton 42U enclosure
- B Cisco UCS 6248UP 48-port fabric interconnect
- C Eaton managed ePDU G3
- D Eaton blanking panels
- E Cisco HX 240c M4
- F Cisco UCS B200 M4 Blade-Series servers
- G Eaton 9PX, 7200 Watt, 6U UPS
- H Eaton external battery module for 9PX UPS, 3U

PDU software capability

There are a number of management tools available to IT professionals

Software is no longer seen as an "add-on" element; it is seen as the backbone to connected power infrastructures. When it comes to your rack PDU, you will want remote access at the very least. The more complex your network closet, campus or enterprise is, the more remote access and control you will want your software to grant you.

1. **Network connectivity** allows you to see the status of your PDU and remotely reboot or turn outlets and sections on/off from a web browser. This is the most basic form of monitoring, and typically an included feature. Using a web browser may be a good choice for small, standalone environments with 1-25 rack PDUs.

2. **Environmental monitoring probes** are a connectivity device that enables you to collect temperature and humidity readings in the rack environment and monitor the environmental data via the onboard LCD screen or remotely using a Telnet connection or standard web browser. You can also monitor the status of two contact closure devices, such as door switches.

3. **Intelligent power management software**

To help guarantee uptime and increase productivity and responsiveness, intelligent power management software is a necessary tool. It goes beyond seeing the status of your PDU, but lets you see status down to server level. It also goes beyond awareness, but lets you address real-time concerns remotely with capabilities to aggregate and manage your power devices.

Software may be included in your UPS or PDU investment, but an upgrade may be necessary for more advanced features like virtualization integration (triggering VM migrations, initiating load shedding and power capping, etc.). Such "control" benefits are well worth keeping devices up and running during a power or environmental event. Regardless, software is a sound, easy to install and easy to use choice for small to medium enterprises and small, standalone environments with 1-200 rack PDUs for a low-medium cost.

UGH! EATON HAS GIVEN YOU ALL THE CONTROL!

Power utilization

While not a one-day job for most, your environmental footprint (and possibly physical footprint) will be much better off as an end result.

Keep your network alive and kicking

Many people are unaware that their servers are running at zero to 15 percent capacity, but according to **National Geographic**, "up to 30 percent of them are drawing power without actually doing anything." An underutilized server is often referred to as a zombie server, and it becoming a very costly issue in IT.

In most cases, underutilized servers are consuming power, yet providing no benefit to users. This may not sound worrisome if you're dealing with one or two servers, but your mind may change after calculating the annual cost in wasted energy. Unless your data center is based in a state where power is considered cheap, you are likely paying quite a bit for this loss. According to the **Wall Street Journal**, 10 million zombie servers worldwide use up power roughly equal in total to eight large power plants.

How do zombie servers emerge?

Zombie servers can be a result of updating equipment or virtualizing your environment and not removing the old, now unused, units. Or, you may have started an expansion project that required more units, but the project got derailed and the units remained in place. Are you waiting for the day you will need that extra capacity? No matter what your situation is, it's time to change this way of thinking and prevent zombie servers from eating your energy.

What do we do to stop the spread of undead machines?

If you are being scrutinized for underutilization, it's time to look at improving network efficiency to allow for significant cost savings and business growth. Everyone is susceptible to these threats, but with a good grasp of what's going on at the rack level, you are capable of preventing equipment from working too hard.

Your PDU can help you survive the zombie server outbreak.

Look for PDUs with advanced functionality to measure from the outlet level. Granular insights from the outlet level will allow you to get control of your PUE. With Level 3 PUE measurement, you know what is drawing power and are empowered to strategically reconfigure your space and to better utilize your equipment. This is a useful tool to IT managers trying to reduce energy consumption and identify zombie servers.

Start here:

- Take inventory.
- Determine how often the network utilizes each server.
- Don't wait. Pull the plug on those zombie servers.
- If you haven't virtualized, consider it.
- Adopt a scalable approach.

PUE measurement	Level 1: Basic	Level 2: Intermediate	Level 3: Advanced
IT equipment energy	UPS outputs	PDU outputs	IT equipment input
Total facility energy	Utility inputs	Utility inputs	Utility inputs
Measurement intervals	Monthly/weekly	Daily/hourly	Continuous (15 minutes or less)

To obtain Level 3 PUE, you must take measurements at the IT equipment level in intervals of at least 15 minutes.

Rack PDUs can offer advanced PUE measurement.

For more information about Eaton's rack PDU offering, visit **Eaton.com/epdu**

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