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This guide is part of an older series of Cisco Smart Business Architecture designs. To access the latest Cisco SBA Guides, go to http://www.cisco.com/go/sba

Cisco strives to update and enhance SBA guides on a regular basis. As we develop a new series of SBA guides, we test them together, as a complete system. To ensure the mutual compatibility of designs in Cisco SBA guides, you should use guides that belong to the same series.

SBA

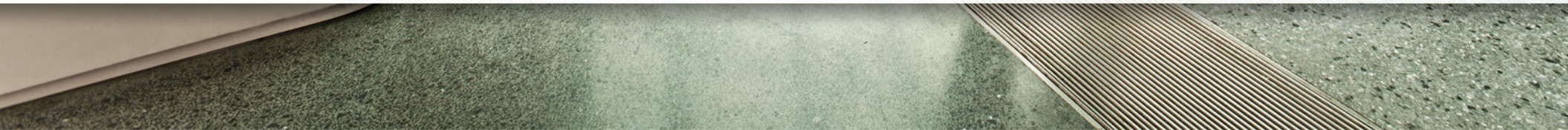
BORDERLESS NETWORKS

DESIGN OVERVIEW

Physical Environmental Specifications Guide

SMART BUSINESS ARCHITECTURE

August 2012 Series



Preface

Who Should Read This Guide

This Cisco® Smart Business Architecture (SBA) guide is for people who fill a variety of roles:

- Systems engineers who need standard procedures for implementing solutions
- Project managers who create statements of work for Cisco SBA implementations
- Sales partners who sell new technology or who create implementation documentation
- Trainers who need material for classroom instruction or on-the-job training

In general, you can also use Cisco SBA guides to improve consistency among engineers and deployments, as well as to improve scoping and costing of deployment jobs.

Release Series

Cisco strives to update and enhance SBA guides on a regular basis. As we develop a series of SBA guides, we test them together, as a complete system. To ensure the mutual compatibility of designs in Cisco SBA guides, you should use guides that belong to the same series.

The Release Notes for a series provides a summary of additions and changes made in the series.

All Cisco SBA guides include the series name on the cover and at the bottom left of each page. We name the series for the month and year that we release them, as follows:

month year Series

For example, the series of guides that we released in August 2012 are the "August 2012 Series".

You can find the most recent series of SBA guides at the following sites:

Customer access: http://www.cisco.com/go/sba

Partner access: http://www.cisco.com/go/sbachannel

How to Read Commands

Many Cisco SBA guides provide specific details about how to configure Cisco network devices that run Cisco IOS, Cisco NX-OS, or other operating systems that you configure at a command-line interface (CLI). This section describes the conventions used to specify commands that you must enter.

Commands to enter at a CLI appear as follows:

```
configure terminal
```

Commands that specify a value for a variable appear as follows:

```
ntp server 10.10.48.17
```

Commands with variables that you must define appear as follows:

```
class-map [highest class name]
```

Commands shown in an interactive example, such as a script or when the command prompt is included, appear as follows:

```
Router# enable
```

Long commands that line wrap are underlined. Enter them as one command:

```
wrr-queue random-detect max-threshold 1 100 100 100 100 100
100 100 100
```

Noteworthy parts of system output or device configuration files appear highlighted, as follows:

```
interface Vlan64
  ip address 10.5.204.5 255.255.255.0
```

Comments and Questions

If you would like to comment on a guide or ask questions, please use the SBA feedback form.

If you would like to be notified when new comments are posted, an RSS feed is available from the SBA customer and partner pages.

Table of Contents

What's In This SBA Guide

Cisco SBA Borderless Networks

Cisco SBA helps you design and quickly deploy a full-service business network. A Cisco SBA deployment is prescriptive, out-of-the-box, scalable, and flexible.

Cisco SBA incorporates LAN, WAN, wireless, security, data center, application optimization, and unified communication technologies—tested together as a complete system. This component-level approach simplifies system integration of multiple technologies, allowing you to select solutions that solve your organization's problems—without worrying about the technical complexity.

Cisco SBA Borderless Networks is a comprehensive network design targeted at organizations with up to 10,000 connected users. The SBA Borderless Network architecture incorporates wired and wireless local area network (LAN) access, wide-area network (WAN) connectivity, WAN application optimization, and Internet edge security infrastructure.

Route to Success

To ensure your success when implementing the designs in this guide, you should first read any guides that this guide depends upon—shown to the left of this guide on the route below. As you read this guide, specific prerequisites are cited where they are applicable.

About This Guide

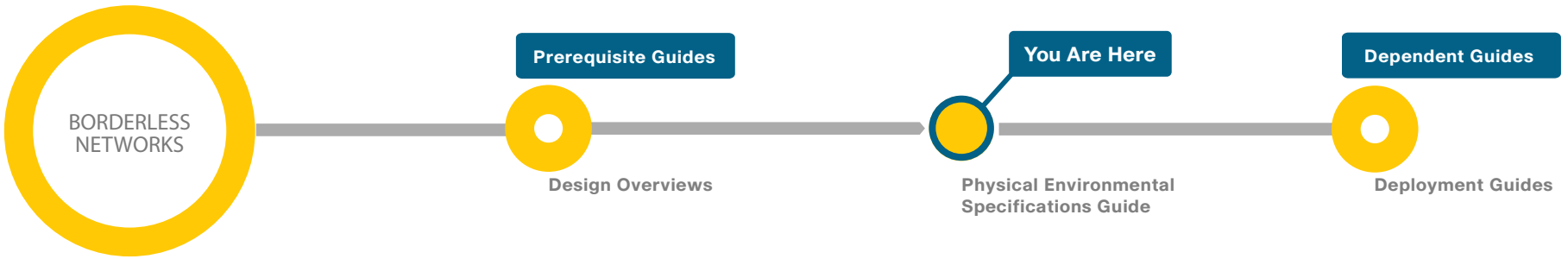
This *design overview* provides the following information:

- An introduction to a Cisco SBA design
- An explanation of the requirements that shaped the design
- A description of the benefits that the design will provide your organization

You can find the most recent series of Cisco SBA guides at the following sites:

Customer access: http://www.cisco.com/go/sba

Partner access: http://www.cisco.com/go/sbachannel



Introduction

With so much hardware on the market today, decisions about which network devices to use and how to set them up can be complicated. This guide outlines the physical environmental specifications of the hardware devices in Cisco Smart Business Architecture (SBA), and discusses some of the problems and solutions associated with mounting, powering, and cooling these devices. It also covers factors that you need to consider when deciding on hardware to include in your design, like available space, whether preexisting electrical and Heating Ventilation and Air Conditioning (HVAC) systems are adequate, and how the building is or will be cabled.

This guide combines many datasheets and filters out the relative information to help ease the decision process. Additionally, the tables in the "Physical Environmental Specifications" section of this guide include details about specific network devices, and are organized by the following locations, where network devices are commonly located:

- Main distribution facility (MDF)
- Intermediate distribution facility (IDF)
- Data center or server room
- Remote site

For more detailed information regarding hardware devices in Cisco SBA, refer to the Physical Environmental Specifications Spreadsheet that accompanies this guide. Additionally, specific information about building a physical infrastructure around Cisco SBA can be found in the *Cisco SBA—Borderless Networks Panduit Physical Infrastructure Reference Guide*.

Business Overview

Reliability and uptime of network services are critical to modern organizations. An important aspect of maintaining reliability and uptime is deploying a physical infrastructure that is built to handle the needs of the devices. Failures due to overheating, tripped circuit breakers, and other environmental factors can lead to unnecessary and costly downtime. Appropriate planning of cooling and electrical systems can avoid these issues and extend the life of network devices.

Careful preplanning of infrastructure can also help avoid delays in deployment of new hardware. Factors like unexpected or missing mounting hardware can cause a project to be delayed while the necessary parts are on order. Understanding how devices are mounted is a factor when deciding on the kind of cabinet or rack used in a deployment. It is also important to plan for the weight and size of devices being deployed, so that the appropriate tools can be on hand while installing the hardware.

Different devices have different power requirements, and therefore different plug types. When deciding on power distribution units (PDUs), the type of plug is an important factor. The chosen PDUs can also affect decisions related to the deployment of electrical systems, or vice versa. Total deployment costs can be reduced by ordering the correct power cable, which is included with most Cisco devices.

Although it may seem trivial, cable organization is an important consideration when designing a physical infrastructure. Unorganized, messy cabling can lead to difficult and, therefore, extended maintenance windows. Determining cable failures without a cable organization and routing strategy is a challenging and time consuming task.

These factors all contribute to the importance of carefully collecting and inspecting the relevant physical environmental specifications for a network deployment. A successful physical infrastructure design reduces network downtime, bypasses installation delays, minimizes unnecessary costs, and accelerates troubleshooting.

Technology Overview

Some of the variables that have to be considered before you choose which devices to implement into your design include mounting, cooling and airflow, power and grounding, and cable management. This section links specific data points like heat load, rack-post support, and power-connector input to design decisions like cooling capacity, cabinet or rack type, and PDU selection.

Mounting

Cisco includes industry-standard 19-inch rack mounting hardware with most devices that are intended to be mounted. Racks and cabinets come in many different varieties for different applications, including options like the number of Rack Units (RU), depth, 2-post or 4-post, enclosed or open, and square or round mounting holes.

The tables in the "Physical Environmental Specifications" section of this guide include information about RU. A standard RU corresponds to 1.75 inches of vertical space in a rack or cabinet. Most of the time, you would choose racks that maximize space utilization by having the greatest possible number of RU. This maximum can be determined by the height of the room where the equipment is held, while taking into account the overhead cable management and standards like TIA-569-B, as well as other variables, such as doorway or elevator clearances leading up to the room. When planning device placement in racks, you need to consider how many racks are needed, which rack will contain which devices, and where the devices will be positioned in each rack.

If you aren't using a "Zero U" PDU solution, it is important to factor in elements like RU reserved for future expansion, cable management, airflow management, and power. As a point of reference, most modern racks are around 42 RU high, but can range anywhere from 2 RU to 48 RU. A nice feature of many racks is markings on the posts (or rails) to indicate the demarcation from one RU to another. Many manufacturers even include numbering to differentiate RU. This simplifies the process of relating a preplanned rack design to the actual physical install of devices in a rack.

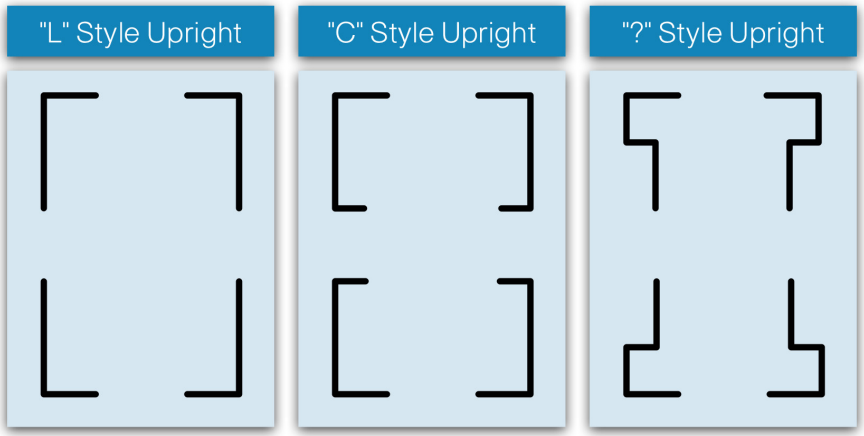
Along with RU, the weight of devices is an important factor in designing a rack layout. Information about the weight of devices can be found in the supplementary Physical Environmental Specifications spreadsheet. Be sure to balance each rack appropriately by placing heavy devices near the bottom of the rack. This ensures that racks do not become top-heavy and run the risk of tipping over. Other factors that go into designing a rack layout, such as heat management, are discussed later in this guide.

In the tables below, there is a field that tells you whether a device includes rack mounting hardware that is designed for a 2-post rack, 4-post rack, or both. Traditionally, 4-post racks or cabinets are used in locations where servers are deployed, like a data center or server room. Two-post racks are found in many places that used to house Telco equipment, but that are still used for smaller deployments, like remote sites with only a router and a switch.

As devices become more densely packed, they become heavier and deeper. This has led to the more common use of a 4-post mounting system. When replacing existing mounting racks or purchasing new racks or cabinets, Cisco recommends that customers deploy 4-post racks, as this design allows for both 4-post and 2-post devices to be mounted. Remember to keep in mind the space between the front and rear posts when you are using a 4-post rack. Most Cisco equipment designed for 4-post mounting includes variable depth brackets, but it is still important that a rack with adjustable depth rails or posts is chosen, which allows for the adjustment of the distance between posts. Another aspect to consider when deciding between 2-post and 4-post is whether an enclosed mounting system is necessary. Enclosed racks or cabinets can be beneficial when controlling airflow, implementing physical access security to devices, and improving the appearance of an equipment room. Most enclosed racks implement a 4-post system. When using an enclosed rack, it is important to carefully consider the overall depth of the devices that will be mounted inside. Since enclosure doors have the possibility of colliding with unusually long equipment, you must factor in variables such as the depth of the device, whether or not the rack mounting hardware extends beyond the depth of the device, the depth of a cable arm if it is being used, clearance for proper cable radii, and the amount of space needed for adequate airflow. To account for these factors, many vendors design racks that are up to 44 inches deep. Determining the total necessary depth can be a very difficult task, as rack mounting hardware doesn't often have documented physical specifications, and is often the culprit of door collision or rack overhang situations. For this reason, Cisco recommends that you choose the deepest rack possible, especially when looking to deploy servers or data center hardware. Information about the depth of devices in Cisco SBA can be found in the Physical Environmental Specifications spreadsheet.

There are three different kinds of rack upright shapes: "L", "C", and "?," as shown in Figure 1. The "L" and "C" style uprights tend to be the most common. Cisco recommends using "L" style uprights, as they are compatible with most networking devices and servers, but be aware that the "C" and "?" style can be more sturdy than "L" style uprights.

Figure 1 - Overhead view of rack upright shapes



Another design consideration is rack-hole style. There are primarily three kinds of rack holes: threaded holes, round unthreaded holes, and square holes. Threaded-hole racks are the original and most common style for older deployments. The holes can be tapped with 10-32, 12-24, or M6 threads, so caution must be taken to ensure the proper screw is used to mount the devices so that you don't accidentally strip the threads. Most Cisco devices include a set of 10-32 screws for mounting purposes. The downside of this style of rack hole is that you run the risk of stripping out the threads if you frequently exchange hardware. For this reason, round unthreaded-hole style was introduced (otherwise known as round hole, clearance hole, or Versa Rail). The benefit of this rack-hole style is that a nut can be used to fasten devices to the rack instead of relying on a threaded rail.

The third type of rack-hole style is the square hole. With the square-hole style, screws aren't required for the rails, so servers can quickly be installed without the need for tools. All of Cisco's Unified Computing System server platforms include sliding rails for square-hole style racks by default. This allows for rapid deployment of large server rooms and data centers. The added benefit of square-hole style racks is that they are compatible with traditional round-hole device mounts by using a cage nut. For this reason, Cisco recommends that, in most cases, you use square-hole style racks to allow for maximum compatibility and reduced server mounting times. Be aware that most Cisco hardware does not include cage nuts.

The tables below list whether the device is made for round-hole style or square-hole style racks. Devices marked with "round" work with both the threaded-hole style and round unthreaded-hole style racks. If you are installing a device that is listed in the table as "round," and are using square-hole style racks, it is recommended that you purchase cage nuts and matching screws. All of the devices that are listed in the table as rack-mountable are compatible with a square-hole style rack. When an existing round-hole mounting solution exists, and there is a need for deploying a device that is only compatible with square-hole, you can mount hole adaptors to allow for proper mounting of the device.

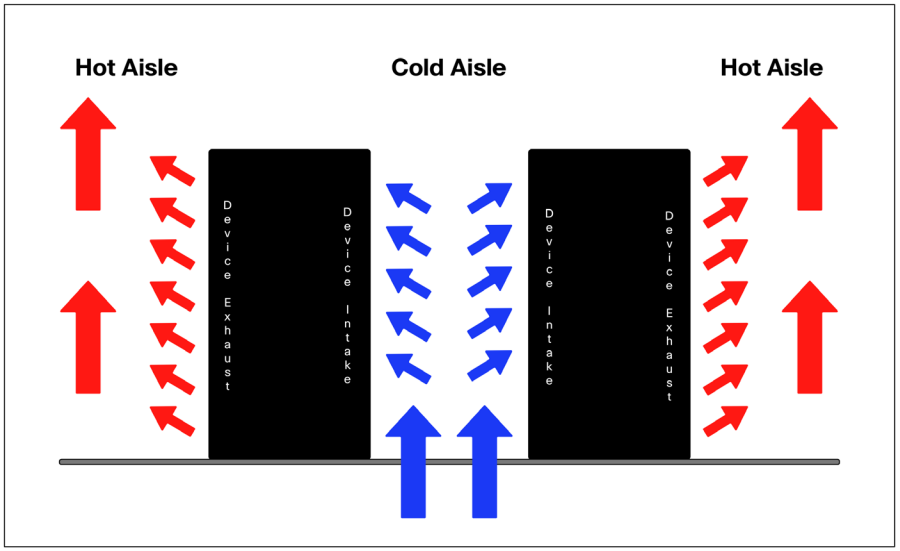
The *Panduit Physical Infrastructure Reference Guide* contains recommendations for specific racks from Panduit that are compatible with Cisco SBA hardware, making the rack design decision process even more straightforward. For more information, go here: http://www.cisco.com/go/sba/

Cooling and Airflow

Cooling and airflow are two of the most challenging aspects of designing an efficient and consistent environment for a networking equipment room. Poor air flow layout, cooling capacity underestimations, and inadequate preexisting building HVAC system design can lead to unnecessary downtime and possible equipment failure.

One of the simplest and most efficient ways to avoid poor airflow is to mount hardware to allow for a "hot aisle, cold aisle" design. This essentially means that intake of a device faces the front of the rack (cold aisle) and the exhaust faces the back (hot aisle), as shown in Figure 2. By avoiding the mixture of cold, air-conditioned air and hot exhaust air, efficiency is gained and cooling costs can be reduced. Predetermined rack layouts can be designed to abide by "hot aisle, cold aisle" best practice by using the Airflow field in the tables below.

Figure 2 - Hot aisle, cold aisle airflow layout



In some cases, it may be difficult or impossible to maintain a consistent front-to-back airflow pattern. For example, when using Cisco Catalyst switches in a server rack. Because of the density of UTP cabling in a server rack, it only makes sense, from a cable management perspective, for all Ethernet ports to face the same direction. However, servers and Catalyst switches both intake air on the same side as their Ethernet ports. When situations like this occur, ensure that exhaust air is not directly taken in by another device's intake. Similar issues can occur with devices that intake or exhaust air from the side of the device. If devices with side-to-side airflow are adjacent to each other, dangerously high heat levels can occur. One workaround is to block the side exhaust by using enclosed racks, although caution must be taken to ensure adequate room for proper airflow. Alternatively, you can use ducting solutions, which redirect side-to-side airflow to front-to-back airflow. The downside is the use of horizontal space. In cases where multiple rows are deployed and "hot aisle, cold aisle" best practice is implemented, blocking panels can be installed in unused RU to avoid contamination between the aisles.

The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHARE) has found that, as an industry standard, the maximum allowable intake temperature for IT equipment is 80.6 degrees F. This should be kept in mind while designing the airflow layout. This should also be practiced while you are actively maintaining a network, as accounting for all variables of airflow management is very difficult. To maintain this standard, adjustments to airflow layout should be made as necessary.

There are two important elements to appropriately sizing cooling capacity: the amount of airflow through a device, or cubic feet per minute (CFM), and the amount of heat created by that device, or wattage (kW). Typically, capacity calculations are based on the standard utilization of a device; this guide bases that standard utilization at 50% of the device's power supply rating. The table below lists both CFM and kW for each device in Cisco SBA. By determining the total CFM and kW for an equipment room, a suitable cooling design can be chosen. In some cases, the facility's preexisting HVAC can be utilized. Other situations may call for a standalone row-based cooling solution, or modification of the current cooling systems. Factors such as future expansion and unusually high load times can make accounting for an additional 50%-100% over calculated capacity a good idea. ASHARE defines the industry standard of acceptable range of relative humidity of the inlet air into IT equipment as 40 to 55%. When designing the cooling systems for equipment closets, you should be aware that humidity levels can be affected drastically by simply turning down the AC.

It is important to remember that, in most cases, using the standard HVAC in a room, which has not been designed for IT equipment, is not a recommended practice. First, it is unlikely that this room has a dedicated conditioning zone. Without this kind of control, maintaining a comfortable temperature for employees, while ensuring acceptable climate levels for IT devices, is impossible. Even when multiple zones do exist, a solid understanding of the cooling ability of the current infrastructure must be obtained. As stated before, this capacity incorporates the two elements CFM and kW. Humidity can become an issue when using an air conditioning system at or near total capacity. Humidity control systems can help mitigate the effects of excessive or insufficient relative humidity. Standard personnel HVAC systems also tend to have low resiliency, so ensuring that cooling systems continue to operate during failures may be impossible.

Ensuring proper design of the cooling and airflow in relation to IT devices can be difficult and sometimes hard to predict. In the *Panduit Physical Infrastructure Reference Guide,* you can find prescriptive guidance about airflow and cooling for Cisco SBA. This guide includes solid recommendations, and even CFM simulations of two different room designs for Cisco SBA, to ensure that your equipment room meets ASHARE standards.

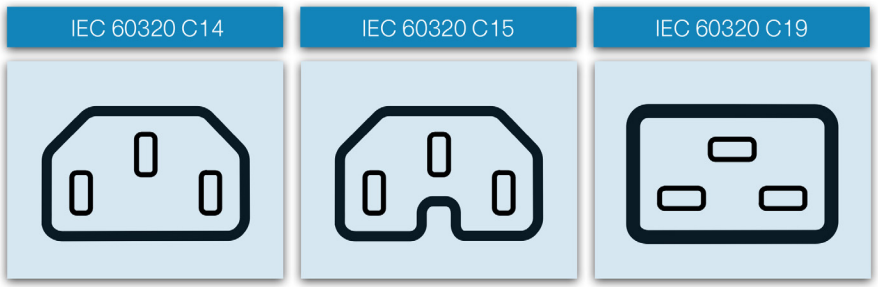
Power and Grounding

This topic tends to get ignored, but it can play a very important role in the success or failure of a network deployment. Making decisions about which PDUs to deploy, how large of an uninterruptible power supply (UPS) is needed, and whether or not grounding is important can be challenging without the correct information.

Modern PDUs (also known as *power outlet units*, or *power strips*) come in almost uncountable varieties. Choosing the correct PDU is an important aspect of designing IT equipment rooms. When sorting through the options of PDUs, the first thing you encounter is the model line. These models are usually differentiated by features, rather than specifications. A few interesting features to keep in mind while searching for PDUs is outlet switching, power metering, and environmental monitoring. These features differ from manufacturer to manufacturer but can generally be very helpful in remote management, power consumption monitoring, and power use reduction.

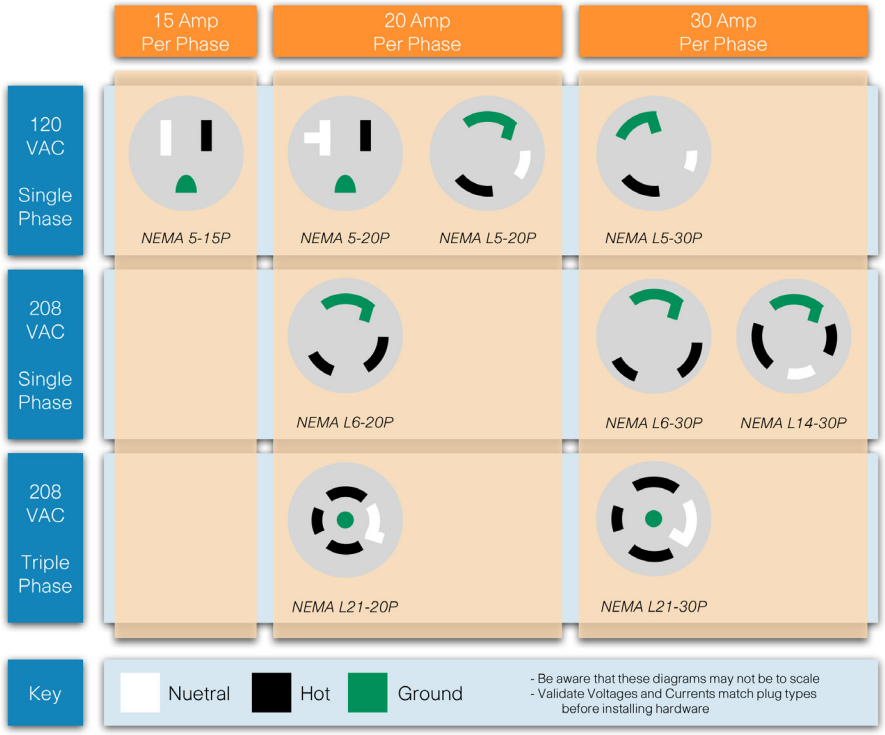
Next, you have to decide how many and what type of plugs are needed. Figure 3 shows the different types of input plugs that Cisco utilizes in its products; additionally, there is a field in the tables below to assist you with PDU selection. Also included in those fields is the number of possible power supplies those devices carry for redundancy and additional wattage purposes. For some equipment, redundancy is important. In these cases, equipping each rack with two PDUs is best practice; this should be taken into account while counting plug types. In most cases, a "Zero U" PDU is deployed, which is simply a way of saying a PDU that doesn't occupy any rack unit space and instead is hung vertically in the rear of a rack. As mentioned before, appropriate space should be accounted for when deciding on a PDU or set of PDUs.

Figure 3 - Plug types used by Cisco devices



The next step is to look at the room's electrical ability and consequently the electrical specifications of the PDUs. Since the amount of variance between deployments is almost endless for this topic, this guide lists only some of the factors you should be aware of when researching this. Extreme caution should be taken when deciding upon the correct PDU; if any confusion or uncertainty exists about the current electrical deployment, then a professional electrician should be contacted. Some of the factors that go into determining the electrical situation are the number of phases (single, two, or three phase), the voltage of each of those phases (in the United States 120VAC or 208VAC), the amps per phase (in the United States 15, 20, or 30, Amps), and the overhead plug type. The overhead plug type can tell you a lot about the type of electrical service that circuit is carrying. Figure 4 illustrates some of the types of sockets in North America and what they mean about the connected circuit. Be aware that the circuit should still be checked to ensure that they plug type is not mismatched with the circuit.

Figure 4 - Common North American overhead socket types



The final and most important consideration when deciding on a PDU is determining whether it can handle the load of the devices that are going to be powered off of it. The same number calculated when estimating heat load can be used when deciding the required power load (usually measured

in kW). Some PDU manufacturers list their specifications in different power measurements than the standard kW. Be sure to be aware of these differences and plan accordingly.

The National Electric Code (NEC) requires that only equipment mounted in a rack be grounded by the ground wire that is part of the AC power connection into the device. If an unusually high amount of electrical surges or transient voltages are expected, then a grounding strategy should be employed. Power surges can be caused by lightning, high-power circuit switching, or faults with the utility company's equipment, and can damage IT equipment, which can cause downtime and lead to expensive replacement of damaged hardware. Every Cisco device is designed with an area that is purposefully left unpainted, and includes a ring terminal with a screw to attach to the device's chassis. This ring terminal can be crimped to a wire that leads to true Earth ground in a variety of ways. The easiest and cleanest way of doing this is to purchase a grounding solution from a vendor. Vendor solutions come in many shapes and sizes, and can even be integrated into the rack solution that is chosen.

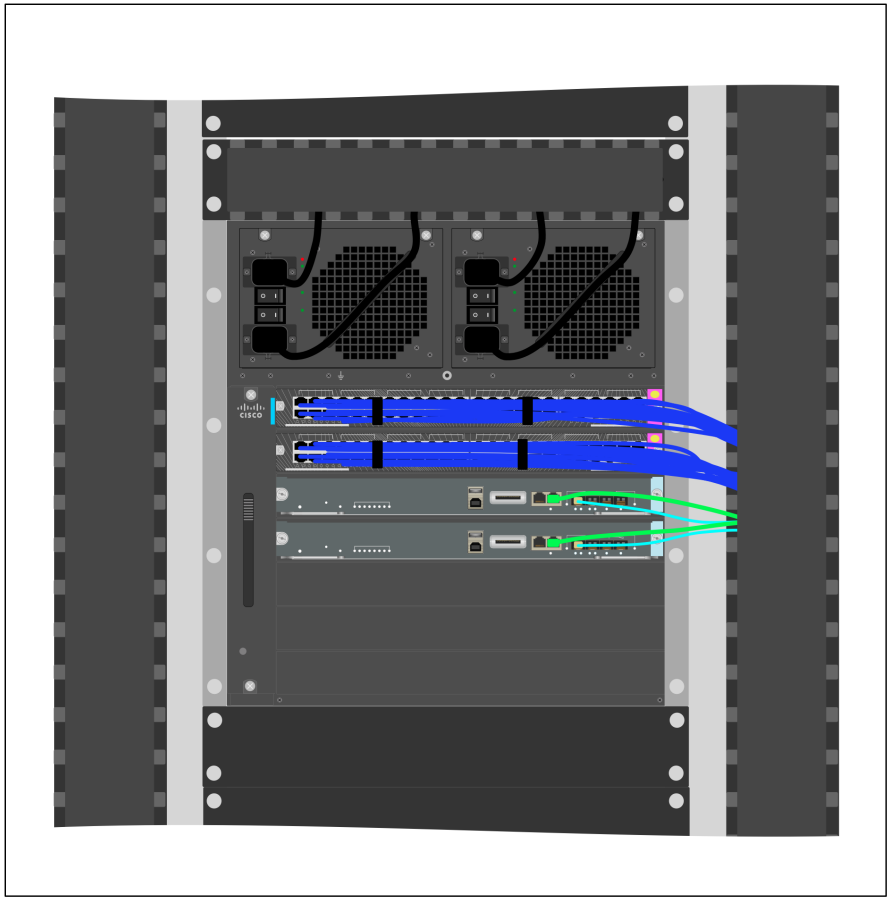
Properly powering and grounding your device can make the difference between a smoothly operating IT environment, and one in which you are constantly resetting breakers or dangerously daisy chaining power strips.

Cable Management

IT cabling organization has a tendency to be bipolar. Either organizations don't set a standard for cable routing and labeling and cables end up everywhere, or a routing and labeling strategy is decided upon and enforced and a professional looking deployment ensues. The following are suggestions for how to maintain a clean and consistent cabling design within your organization.

Replacing and maintaining devices while sustaining uptime can be nearly impossible without using horizontal cabling across devices and even the individual slot of devices. The best cable management ensures that patch cables do not interfere with other devices in the rack, and do not interfere with field replaceable units when possible. Cabling in this way also improves airflow, as cables tend to be bundled in groups, thus reducing blockage of intake and exhaust vents. Most of the time, non-blocking horizontal cabling can be accomplished using vertical and horizontal cable management systems. Caution must be taken when using cable management (and when routing cables in general) to ensure proper cable bending radius. Cable bending radius varies from cable-type to cable-type. Specific bend radii listings are outside the scope of this guide, but it is still important to be aware of this design consideration.

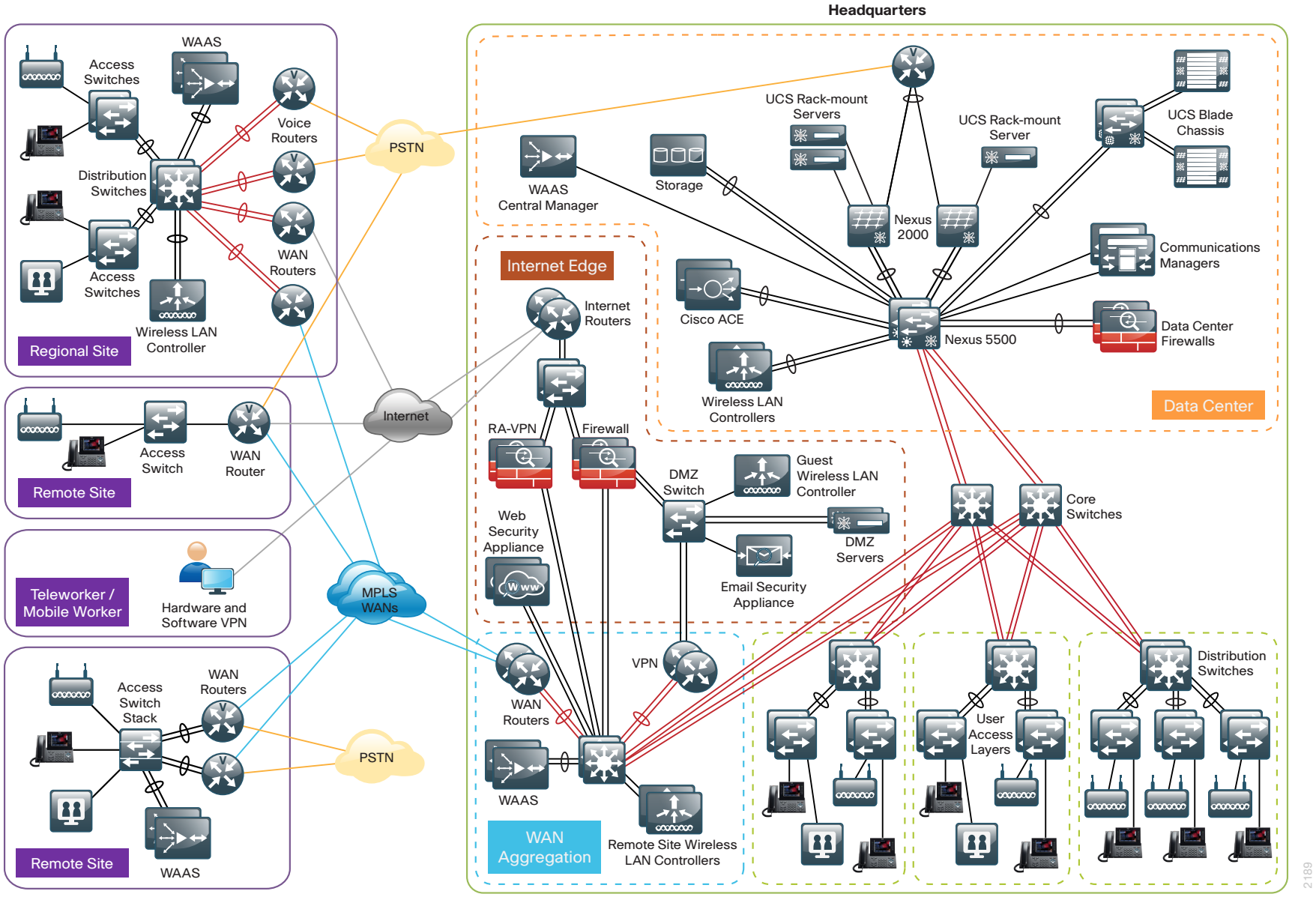
Figure 5 - Example of Cisco Catalyst 4507R+E cable management



You can put into place a labeling system to help speed up cable tracing, and therefore minimize debugging times. Labeling can be done in a few different ways. One option is to use a label maker to create a custom label for each patch cable. The benefit of this kind of system is that specific information about location, as well as which device the patch cable is connected to, can be added to the label. The downside is that each patch cable requires two custom printed labels, and these labels are not only costly, but also take a long time to create. Another option is to purchase patch cables with preprinted matching serial numbers on each end. With this system, entire racks can be deployed quickly and cables can easily be reused for other purposes, if ever removed. The negative aspect to using this labeling system is that only certain cables can be purchased with this kind of labeling

(specifically, newer standards like Twinax tend to lack these kinds of options), and, although both ends match, there is no information about where to find the other end of a cable.

When neat cabling practices are followed from the beginning of a project, there is a higher likelihood that those practices will be continued. Set up a standard in the beginning, and be sure that the entire IT organization is aware of it, otherwise you may face cabling tracing issues.



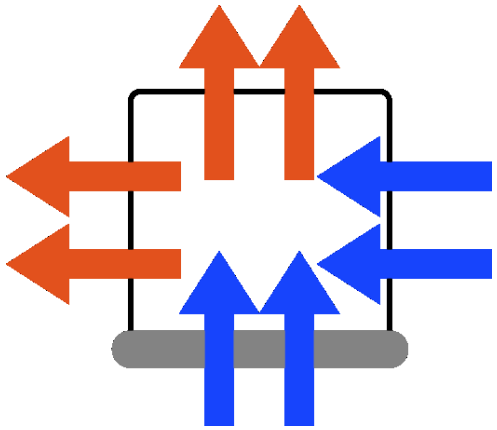
Physical Environmental Specifications

Table 1 - Key to the specification tables

Icon	Description
	Included IEC 60320 C7 Power Connection
	Included IEC 60320 C14 Power Connection
	Included IEC 60320 C15 Power Connection
	Included IEC 60320 C19 Power Connection
	Optional IEC 60320 C14 Power Connection
	Optional IEC 60320 C15 Power Connection
	Optional IEC 60320 C19 Power Connection
	Two Post Round Hole Rack Mounting
	Four Post Round Hole Rack Mounting
	Four Post Square Hole Rack Mounting

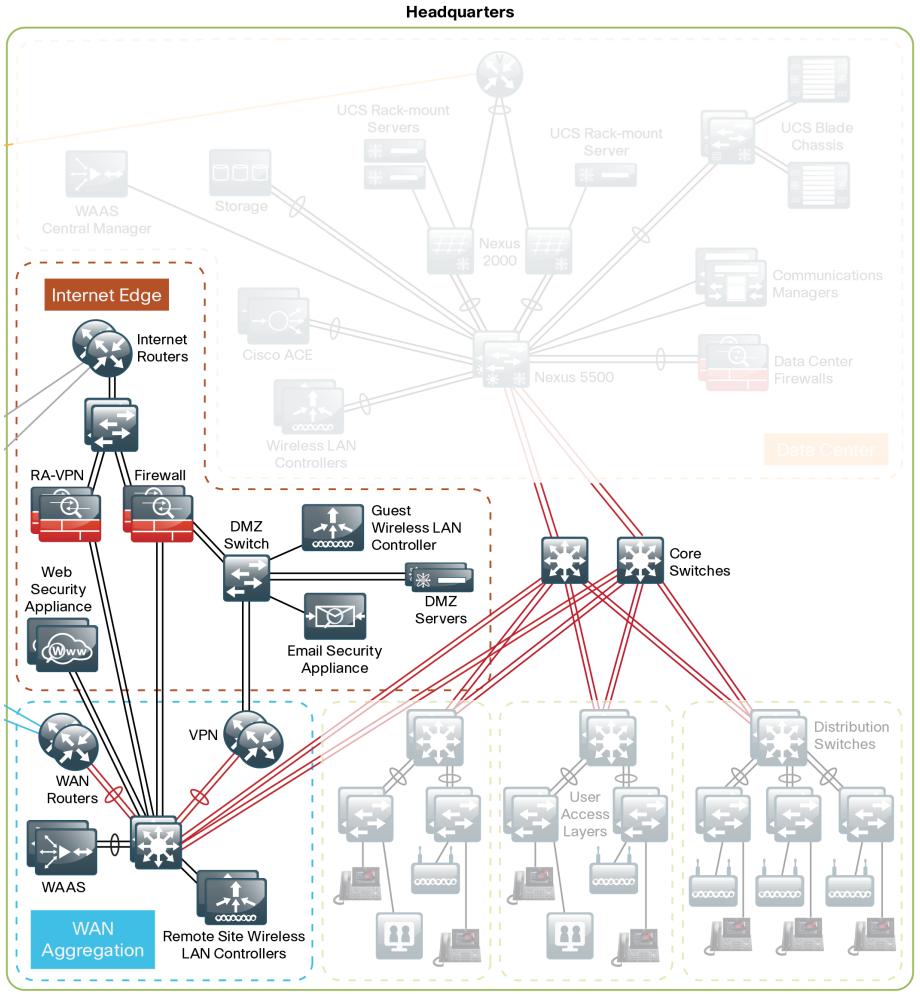
The airflow field has many different iterations. The icons represent airflow and port placement in the following way. Devices are drawn from an overhead view, blue arrows indicate cool air intake, red arrows indicate hot air exhaust, arrows pointing left or right indicate a side airflow style, while upward or downward arrows indicate a front or back airflow style, and the gray bar indicates where the majority of the networking ports reside on the device. For example, Figure 6 illustrates a device that intakes cool air from the front and right side of the device, and exhausts the hot air to the left and out the back of the device. The networking ports are on the front of the device.

Figure 6 - Example of an airflow icon



For more detailed information about each device in the following tables, please refer to the Physical Environmental Specifications spreadsheet that accompanies this guide.

Main Distribution Facility



Notes

Table 2 - Specifications for devices in the main distribution facility

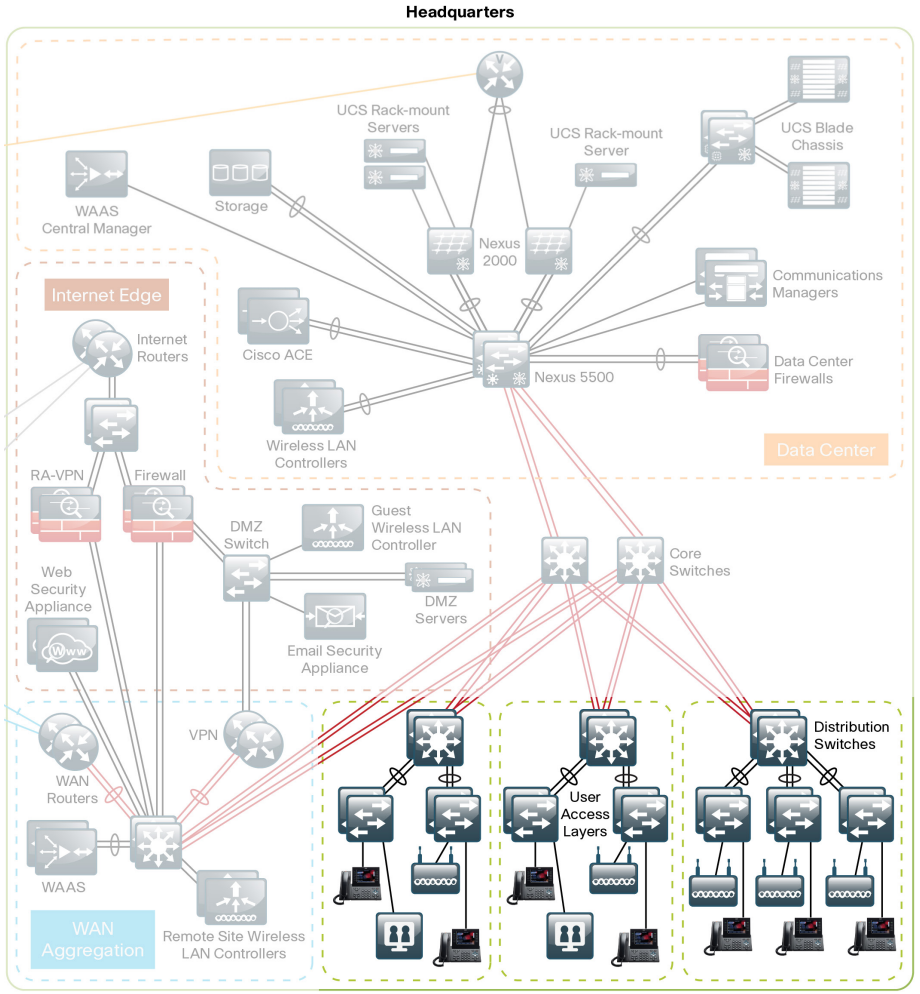
Model	Rack units	Rack style	Airflow	Power input	50% power rating (W)
Cisco Catalyst 6500 E-Series 6-Slot Chassis (WS-C6506-E)	12	2			3000
Cisco Catalyst 4507R+E 7-slot Chassis with 48Gbps per slot (WS-4507R+E)	11	2		See Table 5	See Table 5
Cisco Catalyst 3750-X Series Stackable 12 GbE SFP ports (WS-C3750X-12S-E)	1	2			175
Aggregated Service 1002 Router (ASR1002-5G-VPN/K9)	2	2			290
Aggregated Service 1001 Router (ASR1001-2.5G-VPN/K9)	1	2			235
Cisco 3945E (CISCO3945E-SEC/K9)	3	2			400
Cisco 3945 (C3945-VSEC/K9) (CISCO3945-SEC/K9)	3	2			400
Cisco 3925 (C3925-VSEC/K9) (CISCO3925-SEC/K9)	3	2			400
Cisco 2951 (CISCO2951-SEC/K9)	2	2			375
Wide Area Virtualization Engine 8541 (WAVE-8541-K9)	2	4			365
Wide Area Virtualization Engine 7571 (WAVE-7571-K9)	2	4			365
Wide Area Virtualization Engine 7541 (WAVE-7541-K9)	2	4			365
Wide Area Virtualization Engine 694 (WAVE-694-K9)	1	4			265

Model	Rack units	Rack style	Airflow	Power input	50% power rating (W)
Wide Area Virtualization Engine 594 (WAVE-594-K9)	1	4			265
Cisco ASA 5545-X (ASA5545-IPS-K9) (ASA5545-K9)	1	4			200
Cisco ASA 5525-X (ASA5525-IPS-K9) (ASA5525-K9)	1	2			200
Cisco ASA 5515-X (ASA5515-IPS-K9) (ASA5515-K9)	1	2			35
Cisco ASA 5512-X (ASA5512-IPS-K9) (ASA5512-K9)	1	2			28
Cisco IPS 4520 (IPS-4520-K9)	2	4*			732
Cisco IPS 4510 (IPS-4510-K9)	2	4*			732
Cisco IPS 4360 (IPS-4360-K9)	1	4			225
Cisco IPS 4345 (IPS-4345-K9)	1	2			200
Cisco IronPort Web Security Appliance S370 (S370-BUN-R-NA)	2	4			435
Cisco IronPort Email Security Appliance C370 (C370-BUN-R-NA)	2	4			435

Model	Rack units	Rack style	Airflow	Power input	50% power rating (W)
Cisco Flex 7500 Series Cloud Controllers (AIR-CT7510-3K-K9) (AIR-CT7510-2K-K9) (AIR-CT7510-1K-K9) (AIR-CT7510-500-K9) (AIR-CT7510-300-K9)	1	4			350
Cisco 5500 Series Wireless Controller (AIR-CT5508-500-K9) (AIR-CT5508-250-K9) (AIR-CT5508-100-K9) (AIR-CT5508-50-K9) (AIR-CT5508-25-K9) (AIR-CT5508-12-K9)	1	4			58
Cisco NAM 2220 Appliance with 2x10 Gigabit XFP ports (NAM2220)	2	4			300
Cisco Catalyst 3750-X Series Stackable 48 10/100/1000 Ethernet ports (WS-C3750X-48T-S)	1	2			175
Cisco Catalyst 3750-X Series Stackable 24 10/100/1000 Ethernet ports (WS-C3750X-24T-S)	1	2			175
Cisco Catalyst 3560-X Series Standalone 48 10/100/1000 Ethernet ports (WS-C3560X-48T-S)	1	2			175
Cisco Catalyst 3560-X Series Standalone 24 10/100/1000 Ethernet ports (WS-C3560X-24T-S)	1	2			175

*The IPS 4510 and 4520 do not include rear rail rack mount hardware but based on their weight this hardware is required. Part number ASA5585-REAR-RACK is the rear rail rack mount hardware for the IPS 4500 series, and must be ordered separately.

Intermediate Distribution Facility

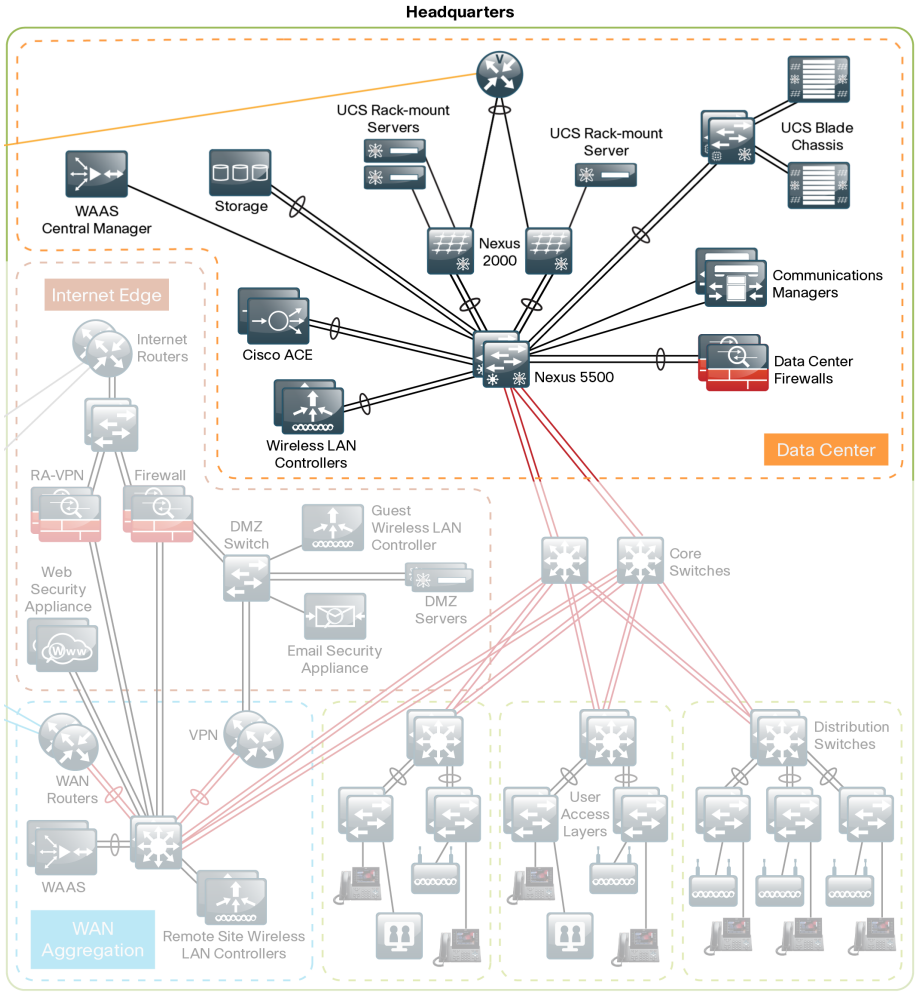


Notes

Table 3 - Specifications for devices in the intermediate distribution facility

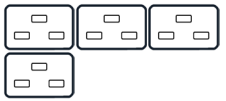
Model	Rack units	Rack style	Airflow	Power input	50% power rating (W)
Cisco Catalyst 4507R+E 7-slot Chassis with 48Gbps per slot (WS-4507R+E)	11	2		See Table 5	See Table 5
Cisco Catalyst 3750-X Series Stackable 48 Ethernet 10/100/1000 PoE+ ports (WS-C3750X-48PF-S)	1	2			360
Cisco Catalyst 3750-X Series Stackable 24 Ethernet 10/100/1000 PoE+ ports (WS-C3750X-24P-S)	1	2			360
Cisco Catalyst 3560-X Series Standalone 48 Ethernet 10/100/1000 PoE+ ports (WS-C3560X-48PF-S)	1	2			360
Cisco Catalyst 3560-X Series Standalone 24 Ethernet 10/100/1000 PoE+ ports (WS-C3560X-24P-S)	1	2			360
Cisco Catalyst 2960-S Series 48 Ethernet 10/100/1000 PoE+ ports (WS-C2960S-48FPD-L) (WS-C2960S-48FPS-L)	1	2			435
Cisco Catalyst 2960-S Series 24 Ethernet 10/100/1000 PoE+ ports (WS-C2960S-24PD-L) (WS-C2960S-24PS-L)	1	2			225

Data Center or Server Room



Notes

Table 4 - Specifications for devices in the data center or server room

Model	Rack units	Rack style	Airflow	Power input	50% power rating (W)
Nexus 7000 C7010 (10 Slot), Chassis (N7K-C7010)	21	4			*
Nexus 7000 C7009 (9 Slot), Chassis (N7K-7009)	15	2			*
Cisco Nexus 5548 up to 48-port 10GbE, FCoE, and Fibre Channel SFP+ (N5K-C5548UP-FA)	1	4			365
Cisco Nexus 5596 up to 96-port 10GbE, FCoE, and Fibre Channel SFP+ (N5K-C5596UP-FA)	2	4			540
Cisco Nexus 2000 Series 48 Ethernet 100/1000BASE-T Fabric Extender (N2K-C2248TP-1GE)	1	4			55
Cisco Nexus 2000 Series 48 Ethernet 100/1000BASE-T (enhanced) Fabric Extender (N2K-C2248TP-E)	1	4			55
Cisco Nexus 2000 Series 32 1/10 GbE SFP+, FCoE capable Fabric Extender (N2K-C2232PP-10GE)	1	4			135
Cisco UCS up to 48-port Fabric Interconnect (UCS-FI-6248UP)	1	4			375
Cisco UCS Blade Server Chassis (N20-C6508)	6	4			**
Cisco UCS C200 M2 Rack Mount Server (R200-1120402W)	1	4			**
Cisco UCS C210 M2 Rack Mount Server (R210-2121605W)	2	4			**
Cisco UCS C250 M2 Rack Mount Server (R250-2480805W)	2	4			**
Cisco MDS 9148 Multilayer Fibre Channel Switch (DS-C9148-8G16P-K9)	1	4			60

Model	Rack units	Rack style	Airflow	Power input	50% power rating (W)
Cisco MDS 9124 Multilayer Fibre Channel Switch (DS-C9124-K9)	1	4			48
Cisco ASA 5585X (ASA5585-S40P40-K9) (ASA5585-S20P20X-K9) (ASA5585-S10P10X-K9)	2	4			385
Cisco ASA 5545-X (ASA5545-IPS-K9)	1	4			200
Cisco ASA 5525-X (ASA5525-IPS-K9)	1	2			200
Cisco Wide Area Virtualization Engine 694 (WAVE-694-K9)	1	4			265
Cisco Wide Area Virtualization Engine 594 (WAVE-594-K9)	1	4			265
Cisco Wide Area Virtualization Engine 294 (WAVE-294-K9)	1	4			200
Cisco ACE 4710 Application Control Engine (ACE-4710-02-K9) (ACE-4710-01-K9) (ACE-4710-2PAK) (ACE-4710-0.5-K9)	1	4			172
Cisco Media Convergence Server 7845-I3 for Unified Communications Manager up to 10,000 users (MCS7845I3-K9-CMD3A)	2	4			500
Cisco Media Convergence Server 7835-I3 for Unified Communications Manager up to 2500 users (MCS7835I3-K9-CMD3A)	2	4			500
Cisco Media Convergence Server 7845-I3 for Unity Connection up to 10,000 users (MCS7845I3-K9-UCC2)	2	4			500

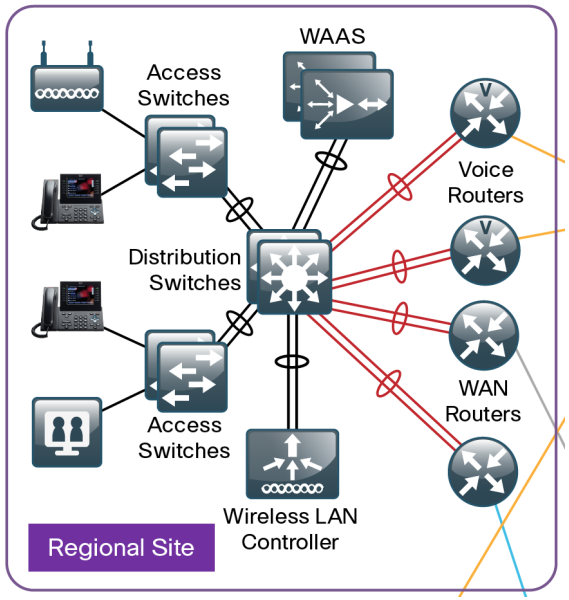
Model	Rack units	Rack style	Airflow	Power input	50% power rating (W)
Cisco Media Convergence Server 7835-I3 for Unity Connection up to 2500 users (MCS7835I3-K9-UCC2)	2	4			500
Unified CMBE6K UCS C200M2 for Unified Communications Manager up to 500 users (UCS-C200M2-BE6K)	1	4			180
Cisco UCS C210 M2 General-Purpose Rack-Mount Server for unified communications applications (UCS-C210M2-VCD2)	2	4			250
Cisco UCS C200 M2 High-Density Rack-Mount Server for unified communications applications (UCS-C200M2-VCD2)	1	4			180
Cisco Media Convergence Server 7845-I3 for Unified Contact Center Express up to 400 agents (MCS7845I3-K9-CCXB1)	2	4			500
Cisco Media Convergence Server 7835-I3 for Unified Contact Center Express up to 100 agents (MCS7835I3-K9-CCXB1)	2	4			500
Cisco TelePresence Video Communication Server Control (CTI-VCS-BASE-K9)	1	2			125
Cisco TelePresence Multipoint Control Unit 4501 (CTI-4501-MCU-K9)	2	2			394
Cisco TelePresence Server 7010 (CTI-7010-TPSRV-K9)	2	2			325
Cisco 3945 (C3945-VSEC/K9)	3	2			400
Cisco 3925 (C3925-VSEC/K9)	3	2			400
Cisco Catalyst 3750-X Series Stackable 48 Ethernet 10/100/1000 ports (WS-C3750X-48T-S)	1	2			175

Model	Rack units	Rack style	Airflow	Power input	50% power rating (W)
Cisco Catalyst 3750-X Series Stackable 24 Ethernet 10/100/1000 ports (WS-C3750X-24T-S)	1	2			175
Cisco Catalyst 3560-X Series Standalone 48 10/100/1000 Ethernet ports (WS-C3560X-48T-S)	1	2			175
Cisco Catalyst 3560-X Series Standalone 24 10/100/1000 Ethernet ports (WS-C3560X-24T-S)	1	2			175

*The Cisco Nexus 7000 environmental data can vary greatly based on the modules installed. For a datasheet containing Nexus 7000 environmental data, go here: http://www.cisco.com/en/US/prod/collateral/switches/ps9441/ps9402/ps9512/Data_Sheet_C78-437759.html

**Information about Cisco UCS power draw is dependent on the specific configuration of different servers. Cisco provides a calculator to ease the planning of a data center or server room, which you can find here: http://express.salire.com/Go/Cisco/Cisco-UCS-Power-Calculator.aspx

Remote Site



Notes

Table 5 - Specifications for devices at a remote site

Model	Rack units	Rack style	Airflow	Power input	50% power rating (W)
Cisco 3945 (C3945-VSEC/K9)	3	2			400
Cisco 3925 (C3925-VSEC/K9)	3	2			400
Cisco 2951 (C2951-VSEC/K9)	2	2			375
Cisco 2921 (C2921-VSEC/K9)	2	2			375
Cisco 2911 (C2911-VSEC/K9)	2	2			165
Cisco 1941 (C1941-WAASX-SEC/K9)	2	2			55
Cisco Wide Area Virtualization Engine 694 (WAVE-694-K9)	1	4			265
Cisco Wide Area Virtualization Engine 594 (WAVE-594-K9)	1	4			265
Cisco Wide Area Virtualization Engine 294 (WAVE-294-K9)	1	4			200
Wireless LAN Controller 2504 (AIR-CT2504-50-K9) (AIR-CT2504-25-K9) (AIR-CT2504-15-K9) (AIR-CT2504-5-K9)	1	2*			40

*The Wireless LAN Controller 2504 doesn't include rack mounting hardware. Part number AIR-CT2504-RMNT= is the rack mounting hardware for the WLC 2504, and must be ordered separately.

Modular Power Supplies

Cisco Catalyst 4500 Modular Power Supplies

The Cisco Catalyst 4507R+E chassis has two available slots for modular power supply units (PSUs). The Catalyst 4500 series can be configured to run multiple supplies in two modes: redundant and combined. For more information about Catalyst 4500 PSUs, go here: http://www.cisco.com/en/US/docs/switches/lan/catalyst4500/hardware/catalyst4500e/installation/guide/0aspecs.html

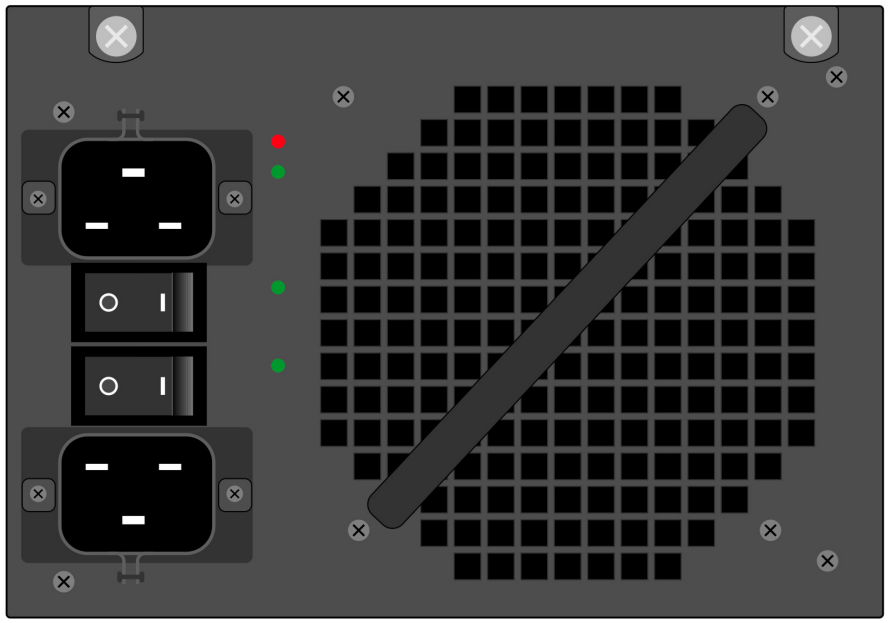


Table 6 - Cisco Catalyst 4500 power supply options

Part number	Power input	50% power rating (W)	Maximum PoE output (W)
PWR-C45-6000ACV		3000	4600
PWR-C45-4200ACV		2100	3700
PWR-C45-2800ACV		1400	1400
PWR-C45-1400AC		700	—
PWR-C45-1000AC		500	—

Cisco Catalyst 3750-X and 3560-X Modular Power Supplies

The Cisco Catalyst 3750-X and 3560-X lines of switches feature available dual redundant, modular power supplies. By default, these switches ship with a single power supply. If a second power supply is desired, it can be purchased at a later time. For more information about Catalyst 3750-X and 3560-X power supplies, go here: http://www.cisco.com/en/US/prod/collateral/switches/ps5718/ps6406/data_sheet_c78-584733.html

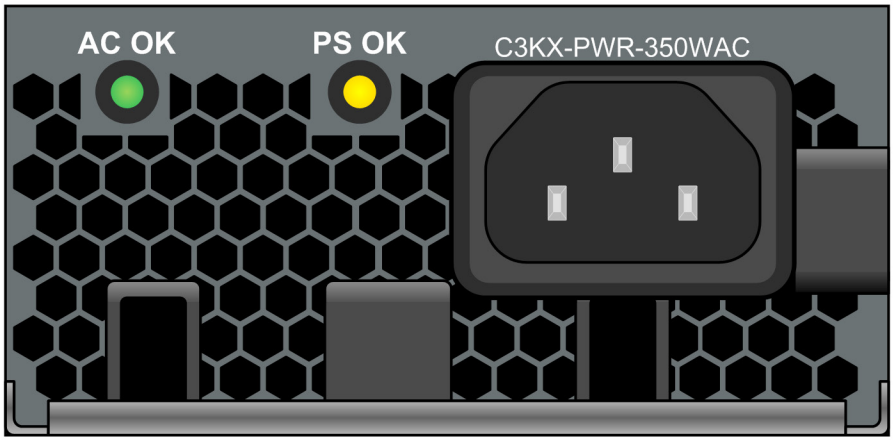


Table 7 - Cisco Catalyst 3750-X and 3560-X power supply options

Part number	Power input	50% power rating (W)	Maximum PoE output (W)
C3KX-PWR-1100WAC		550	800
C3KX-PWR-715WAC		358	435
C3KX-PWR-350WAC		175	—

Notes

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