CHAPTER 2

Site Planning Considerations

This chapter explains how to plan your site for installation of the Cisco 6400 carrier-class broadband aggregator. The Cisco 6400 can be installed in any area that meets the specifications and requirements outlined in this chapter.

To ensure normal system operation and avoid potential post-installation problems, you should choose an appropriate location for your Cisco 6400 and prepare the site properly for installing equipment *prior to* system delivery.

Site Preparation Checklist

Complete the checklist in Table 2-1 several weeks before taking delivery of your Cisco 6400.

Table 2-1 Cisco 6400 Site Preparation Checklist

Checkoff Column	Task Description
	Choose a location for your Cisco 6400 that meets the requirements described in the "Site Selection Guidelines" section on page 2-2.
	Ensure that your site meets the power requirements described in the "Site Power Requirements" section on page 2-5.
	Determine the type of mounting to be used when installing the Cisco 6400, as described in the "Cisco 6400 Mounting Options" section on page 2-7.
	Ensure that the equipment rack in which you plan to install the Cisco 6400 meets the requirements described in the "Rack Selection Guidelines" section on page 2-8.
	Select an appropriate location for your equipment rack, as described in the "Rack Placement Guidelines" section on page 2-8.
	Install the Cisco 6400 in the equipment rack, as described in the "Cisco 6400 Installation Guidelines" section on page 2-9.
	Ensure that the Cisco 6400 chassis is fully enclosed prior to operation, as described in the "Integrity of Chassis Enclosure" section on page 2-12.
	Plan your network and Cisco 6400 interface connections, as described in the "Cabling Requirements" section on page 2-12.

Table 2-1 Cisco 6400 Site Preparation Checklist

Checkoff Column	Task Description
	Ensure that the Cisco 6400 chassis is properly grounded, as described in the "System Grounding Requirements" section on page 2-16.
	Observe proper safety and operating precautions during Cisco 6400 installation and operation, as described in the "Safety Guidelines" section on page 2-17.

Site Selection Guidelines

The Cisco 6400 is designed to run in the following conditions:

- Noncorrosive
- Relatively dust-free
- Dry
- Clean
- Well ventilated
- Air conditioned

You should consider all of these factors in selecting a suitable location for your Cisco 6400.

Site Environmental Requirements

Table 2-2 details the environmental requirements that your site should meet to ensure a proper operating environment for your Cisco 6400.

Table 2-2 Cisco 6400 Environmental Requirements

Characteristic	Minimum	Maximum
Temperature, ambient operating range at sea level (760 mm Hg)—in compliance with GR-63. Short-term operating temperature is limited to 55°C.	25°F (–4°C)	104°F (40°C)
Temperature, ambient nonoperating and storage	–40°F (–40°C)	167°F (75°C)
Relative humidity (RH), ambient (noncondensing) operating	5%	95%
Altitude, operating and nonoperating	–200 ft (–61 m)	10,000 ft (3048 m)
Vibration, operating	N/A	5 to 200 Hz, 0.5 g (1 oct./min)
Vibration, nonoperating	N/A	5 to 200 Hz, 0.5 g (1 oct./min)

Cisco 6400 Physical Characteristics

Knowing the physical characteristics of your Cisco 6400 can help you to choose an appropriate location for the system. Table 2-3 lists the dimensional and weight characteristics of the Cisco 6400, both as a standalone system and as packaged in a shipping crate ready for customer delivery. (See Figure 2-1)

Table 2-3 Cisco 6400 Physical Characteristics

Characteristic	Cisco 6400 Standalone Chassis	Cisco 6400 Packaged for Shipment
Height	21.75 in. (55.2 cm)	33 in. (83.8 cm)
Width	17.5 (44.5 cm)	24 in. (61 cm)
Depth	12 in. (30.5 cm)	33 in. (83.8 cm)
Weight of fully configured chassis	130 lb (59.02 kg)	160 lb (72.6 kg)

Figure 2-1 Cisco 6400 Packaged for Shipment

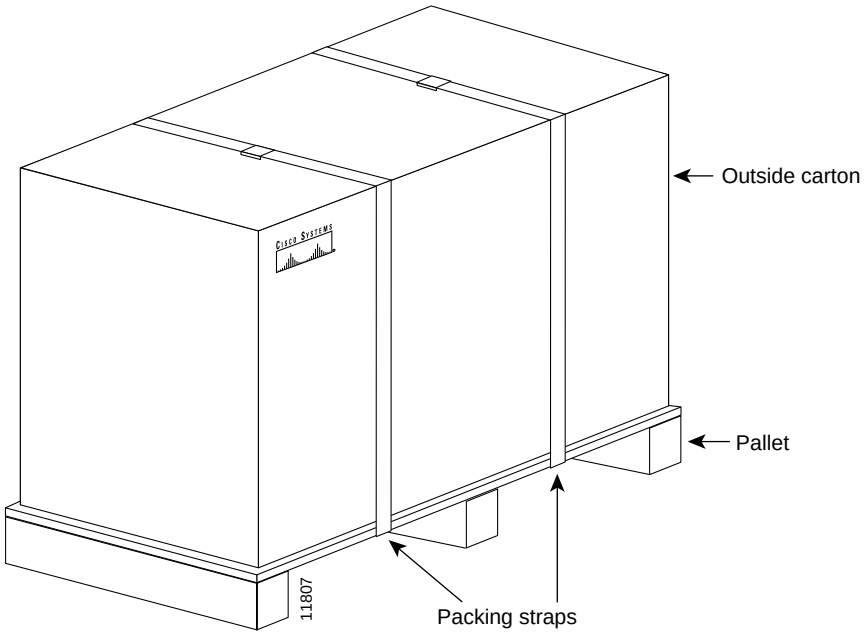
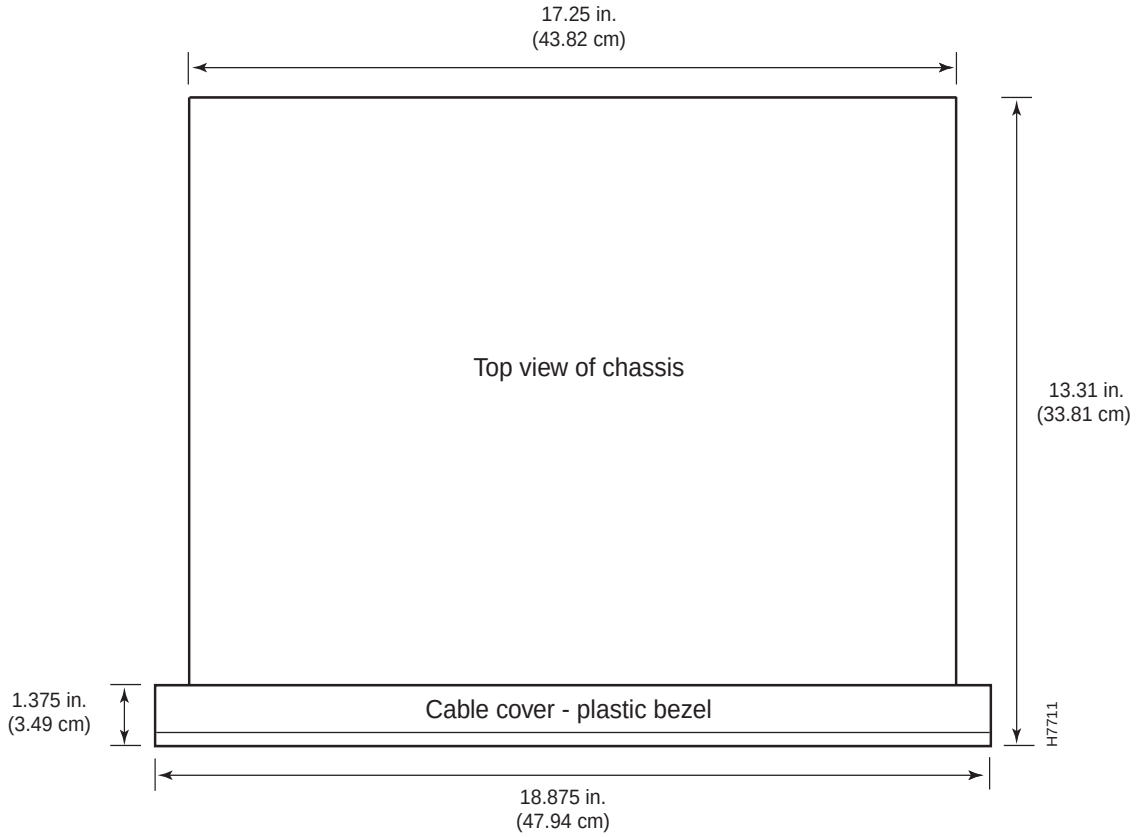


Figure 2-2 Cisco 6400 Chassis Footprint



Floor Loading Considerations

You should ensure that the floor under the telco rack in which you plan to install the Cisco 6400 (together with any other equipment) is capable of supporting the combined weight of the rack and all other installed equipment.

Using Table 2-4, you can calculate the approximate total weight of your Cisco 6400, as ordered for delivery. Add the weight of each individual component in Table 2-4, as appropriate, to the weight of the empty chassis (which includes the cable cover).

For additional information about floor loading requirements, consult the document *GR-63-CORE, Network Equipment-Building System (NEBS) Requirements: Physical Protection.*

Table 2-4 Cisco 6400—Weight of Individual Components

System Element	Weight
Empty chassis, with cable cover (plastic bezel)	37.80 lb (17.16 kg)
Power Entry Module AC PEM DC PEM	 10.90 lb (4.95 kg) 6.20 lb (2.81 kg)
Blower module	10.95 lb (4.97 kg)

Table 2-4 Cisco 6400—Weight of Individual Components

System Element	Weight
Node switch processor (NSP) card	8.00 lb (3.63 kg)
Node route processor (NRP) card	5.00 lb (2.27 kg)
Line card carrier	2.00 lb (0.91 kg)
Node line card (NLC): OC-3/STM-1 DS3 OC-12/STM-4	 1.85 lb (0.84 kg) 1.85 lb (0.84 kg) 5.00 lb (2.27 kg)
Line card carrier with two NLCs installed	5.70 lb (2.59 kg)
Approximate total weight of fully populated chassis	130.00 lb (59.02 kg)

Site Power Requirements

Either a centralized DC source or an AC source can power the Cisco 6400. For DC sources, the Cisco 6400 can be configured with a DC PEM. For AC sources, the Cisco 6400 can be configured with either an AC PEM, or a DC PEM used in conjunction with the Cisco 6400 AC power shelf.

Each Cisco 6400 requires a dedicated branch circuit. If you equip your Cisco 6400 with dual power feeds, you should provide an independent power source for each cord. Doing so avoids compromising the power redundancy feature of the system.

Warning **Connect the unit only to a DC power source that complies with the Safety Extra-Low Voltage (SELV) requirements in IEC 60950 based safety standards.**

The following notice applies to every Cisco 6400:

This device complies with FCC Rules, Part 15. Operation is subject to the following conditions:

- This device may not cause harmful interference.
- This device must accept any interference that may be received, including interference that may cause undesired operation.

Cisco 6400 Electrical Characteristics

Table 2-5 lists the power consumption and heat dissipation characteristics of Cisco 6400 components. This information is useful in assessing the need for additional air conditioning capacity in your site.

Table 2-5 Cisco 6400 Power/Heat Dissipation Characteristics

System Configuration	Power Consumption	Heat Dissipation
Base system with AC power	400W	1367 Btu/hr
Redundant base system with AC power	550W	1879 Btu/hr
Base system with DC power	335W	1145 Btu/hr
Redundant base system with DC power	445W	1528 Btu/hr

Table 2-5 Cisco 6400 Power/Heat Dissipation Characteristics

System Configuration	Power Consumption	Heat Dissipation
Optional components: Redundant NSP NRP NLC Redundant PEM	 125W 100W 25W 10W	 427 Btu/hr 342 Btu/hr 85 Btu/hr 34 Btu/hr
Maximum system power consumption and heat dissipation	1200W	4098 Btu/hr

Table 2-6 outlines the electrical specifications of the DC PEM for the Cisco 6400.

Table 2-6 Cisco 6400 DC Power Ratings

Characteristic	Description
Input connections	Supports up to two separate –48 VDC input feeds by means of 2-position terminal blocks built into the Cisco 6400 backplane
DC input voltage	–48 VDC/–60 VDC
DC input current rating	Maximum power budget: 20A @ –48 VDC
Power consumption	1200W maximum
Heat dissipation	4098 Btu/hr maximum

Table 2-7 outlines the electrical specifications of the AC PEM for the Cisco 6400.

Table 2-7 Cisco 6400 AC PEM Power Ratings

Characteristic	Description
AC inlet power connector	IEC 320 C20
AC input voltage	100 - 240 VAC, 50/60 Hz, single phase
AC input current	15 - 7A
Power consumption	1400W maximum
Heat dissipation	4760 Btu/hr maximum

Table 2-8 outlines the electrical specifications of the optional AC power shelf that you can use for powering your Cisco 6400 in lieu of the DC input power distribution system in the Central Office (CO) environment. The AC power shelf provides the required –48 VDC source voltage for the DC PEM.

Table 2-8 Cisco 6400 AC Power Shelf Power Ratings

Characteristic	Description
AC inlet power connector	IEC 320 C20
AC input voltage	200 - 240 VAC, 50/60 Hz, single phase
AC input current	6A

Table 2-8 Cisco 6400 AC Power Shelf Power Ratings

Characteristic	Description
Power consumption	1400W maximum
Heat dissipation	4760 Btu/hr maximum

Electromagnetic Interference Considerations

When signal wires are run for any significant distance, two types of interference can be induced on the wires:

- Radio frequency interference (RFI)
- Electromagnetic interference (EMI)

Strong EMI, especially when caused by lightning or nearby radio transmitters, can destroy the signal drivers and receivers in the Cisco 6400 and even create an electrical hazard by conducting power surges through power lines into installed equipment.

Note To prevent or remedy interference problems, you may need to consult RFI/EMI experts.

If signal wires exceed recommended cabling distances, or if signal wires pass between buildings, you should give special consideration to the effect that a lightning strike in your vicinity might have on electrical equipment.

The electromagnetic pulse (EMP) generated by lightning or other high-energy phenomena can couple enough energy into unshielded conductors to damage or destroy electronic equipment. If you have previously experienced such problems, you should consult with RFI/EMI experts to ensure that you have adequate electrical surge suppression and shielding of signal cables in your Cisco 6400 operating environment.

Most data centers cannot avoid the infrequent, but potentially catastrophic, problems described above without using pulse meters and other special equipment. Identifying and resolving such potential problems can consume substantial time and money. Nevertheless, you should ensure that you have a properly grounded and shielded electrical environment, paying special attention to the need for electrical surge suppression.

Cisco 6400 Mounting Options

The Cisco 6400 can be mounted in the following ways:

- Flush-mounting in a 19-inch equipment rack
- Center-mounting in a 19-inch equipment rack
- Center-mounting in a 23-inch equipment rack
- Alternate mounting arrangements, such as shelf mounting

Note Alternate mounting arrangements cannot be used when the Cisco 6400 chassis is used with its optional AC power shelf. When used with the AC power shelf, the Cisco 6400 chassis and the AC power shelf must be flush-mounted in a 19-inch rack, with the AC power shelf directly below the Cisco 6400. The Cisco 6400 can never be mounted on the floor.

For a detailed description of the mounting options for the Cisco 6400, refer to the *Cisco 6400 Hardware Installation and Maintenance Guide.*

Rack Selection Guidelines

Cisco recommends that you obtain an equipment rack that has the following characteristics:

- NEBS compliant, 19-inch (48.3 cm) wide rack; or NEBS compliant 23-inch (58.4 cm) wide rack.

  To center-mount a Cisco 6400 in a 23-inch telco rack, an optional 19-inch/23-inch Rack Adapter Kit (Part Number C6400-23Adpt-Set=) is required. Use your standard ordering procedures to obtain this kit from Cisco.

  For a description of this hardware and the rack mounting procedure, refer to the *Cisco 6400 Hardware Installation and Maintenance Guide.*
- RETMA hole patterns in the mounting rails. Required mounting hardware (screws, clip nuts, and dress washers) are shipped with your Cisco 6400. If the rack in which you plan to install your Cisco 6400 has metric-threaded rails, you must provide your own metric mounting hardware.
- Leveling feet.
- Perforated top (for ventilation).
- Open bottom.
- Solid side panels.
- Front and rear doors (optional)—If present, the doors must be fully louvered to ensure adequate ventilation.

Note Ensure rack stability when you are installing your Cisco 6400. The rack/Cisco 6400 combination should comply with UL Standard 1950, Par. 4.1.1 and IEC 950, 4.1.1. You should install heavy equipment at or near the bottom of the rack to lower the center of gravity and enhance rack stability.

If you already have an equipment rack that meets these basic requirements, you should review its present location at your site, giving full consideration to the Cisco 6400 installation guidelines and requirements provided in this document.

Rack Placement Guidelines

You should allow at least 3 to 4 feet of clearance in front of the rack for normal system maintenance and for removing and inserting the following Cisco 6400 components:

- Node switch processors (NSPs)
- Node route processors (NRPs)
- Node line cards (NLCs)

- Power entry modules (PEMs)
- Fan assembly

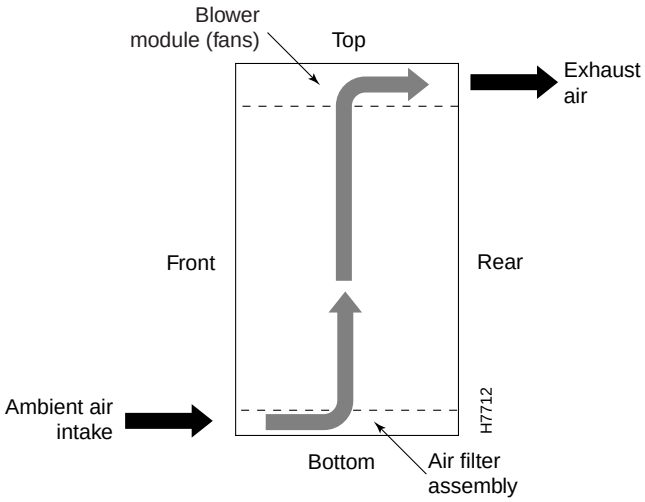
Cisco 6400 Installation Guidelines

These guidelines are based on the assumption that you will be mounting your Cisco 6400 in a standard telco rack.

The Cisco 6400 is equipped with an internal blower module that draws ambient air into the unit from the bottom front and sides of the chassis and exhausts it out the top rear and sides of the chassis. (See Figure 2-3.) This ambient airflow pattern through the Cisco 6400 must be maintained at all times to ensure normal system operation and to prevent overtemperature conditions within the chassis.

To minimize the potential for thermal problems, you should place the chassis in the rack so that the air intake at the bottom front of the enclosure (see Figure 2-3) is not near the exhaust vents of other equipment. Similarly, you should ensure that the Cisco 6400 exhaust vent at the top rear of the enclosure (see Figure 2-3) is not near the air intake of other adjacent equipment.

Figure 2-3 Path of Cooling Air through the Cisco 6400



Side panels can be installed in a rack that is housing a Cisco 6400 without posing potential overheating problems for the system, but the air intake on the bottom front of the chassis and the exhaust vents at the top rear of the chassis should not otherwise be blocked or restricted.

If the ambient air being drawn into the chassis is blocked, restricted, or too warm, an overtemperature condition can occur within the system. Under extreme conditions, an internal environmental monitoring facility will shut down the system to protect its internal circuitry.

Overtemperature conditions within the Cisco 6400 can occur under any of the following circumstances:

- The rack housing the Cisco 6400 does not permit adequate ventilation.
- The exhaust air from adjacent equipment is being drawn into the Cisco 6400.
- The Cisco 6400 is installed at the top of an unventilated rack.

A temperature or humidity level that approaches the limits specified in Table 2-1 should be regarded as a potential problem. To help ensure normal system operation following Cisco 6400 installation, you should anticipate and correct any potential environmental anomalies before the system is delivered.

Rack Mounting Considerations

You should observe the following guidelines when installing the Cisco 6400 in a telco rack:

- Avoid installing the Cisco 6400 in an overly congested rack.

  The ambient air intake for the Cisco 6400 chassis is located at the bottom front of the enclosure. (See Figure 2-3.) The exhaust vent is located at the top rear of the enclosure.

  This pattern of airflow through the chassis enables multiple Cisco 6400s to be mounted in a rack with little or no vertical separation between them. However, the presence of other equipment in the rack with different airflow patterns should be taken into account in determining the best placement of your Cisco 6400. For example, you should ensure that exhaust air from other equipment in the same or an adjacent rack is not directed toward the ambient air intake at the bottom front of the Cisco 6400.

- Take into account any other equipment installed in the rack and the routing of associated interface cables for the equipment.

  Ensure that cables from other equipment will not obstruct the flow of cooling air through the Cisco 6400 or impair access to its installed components.

  Route interface cables away from any installed field-replaceable units (FRUs), if possible, so that you do not need to disconnect cables from the Cisco 6400 FRUs to perform equipment maintenance or upgrades.

  You should also take into account the interface cables associated with the Cisco 6400 and how such cables should be arranged in the presence of interface cables for other equipment installed in the same or an adjacent rack.

- Install the heaviest equipment at or near the bottom of the rack to ensure the lowest possible center of gravity for all the equipment in the rack.

- Ensure that the equipment shelf, if you plan to use one, is constructed to accommodate the weight and dimensions of the Cisco 6400.

  Refer to Figure 2-2 for the chassis footprint that you must take into account if you plan to use a customized shelf for rack-mounting the Cisco 6400.

- Mount the Cisco 6400 at the bottom of the rack if it is the only piece of equipment to be installed in the rack.

- If stabilizing devices are available for the rack in which you plan to install the Cisco 6400, secure them before rack-mounting the system.

In addition to the guidelines outlined above, review the precautions for avoiding overtemperature conditions in the "System Ventilation Precautions" section on page 2-20.

For additional information about the proper placement of electronic equipment in your site, consult the document *GR-63-CORE, Network Equipment-Building System (NEBS) Requirements: Physical Protection.*

Routing of Interface Cables

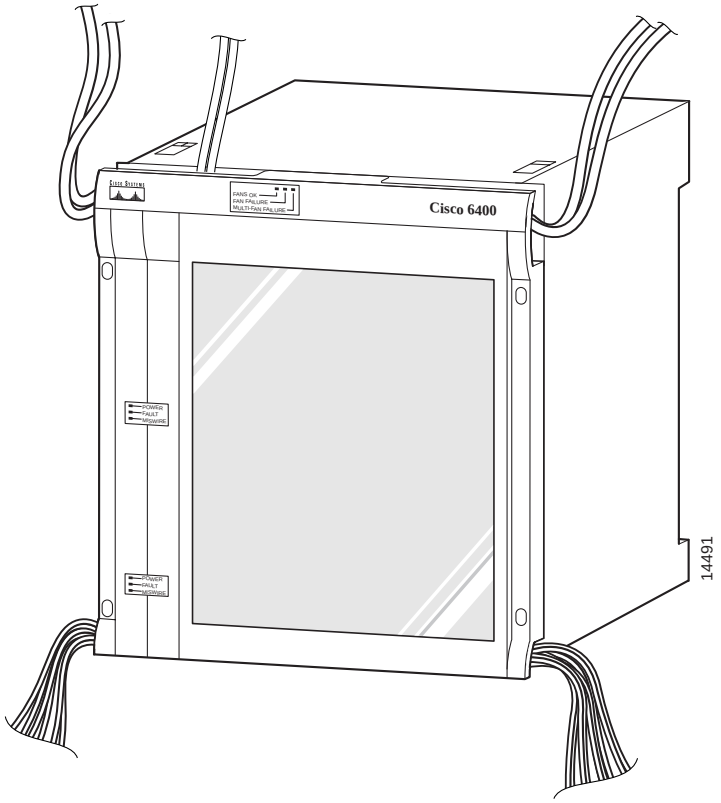
When you choose a rack location for installing your Cisco 6400, take into account the following cable routing requirements:

- Connectivity to the console (CON) and AUX (modem) ports on the node switch processor (NSP) card and the node route processor (NRP) card

- Connectivity to the 10BaseT Ethernet (ETH) port and the 100BaseT Fast Ethernet (FE) port on the NRP card; connectivity to the Ethernet (ETH) port on the NSP card
- Connectivity to the ATM ports on OC-3/STM-1, DS3 and OC-12/STM-4 node line cards (NLCs)
- Connectivity of Cisco 6400 components to associated equipment in the central office (CO), that is, connectivity to equipment in the same rack or adjacent racks, or connectivity to the CO backbone network

Figure 2-4 shows a Cisco 6400 with interface cables of various types routed through openings in the cable cover (smoked plastic bezel) attached to the front of the chassis. This cover not only dresses the front of the Cisco 6400, but also helps you neatly arrange the interface cables and keep them securely connected to chassis components.

Figure 2-4 Typical Interface Cable Routing in the Cisco 6400



The interface cable layout in your Cisco 6400 might differ from that shown in Figure 2-4, depending on the circuit boards installed in the chassis and the termination points of associated interface cables.

Although obscured from view in Figure 2-4 by the cable cover, cable management brackets attached to the top front and bottom front of the Cisco 6400 chassis help you to neatly arrange all of the interface cables attached to individual circuit boards. Figure 1-1 shows the location and physical configuration of these cable management brackets.

Cisco recommends using the top cable management bracket for managing the appropriate interface cables for the console (CON), auxiliary (AUX), 10BaseT (Ethernet), and 100BaseT (Fast Ethernet) ports on NSP cards and NRP cards. Cisco also recommends that you leave a service loop in the interface cables at the top corners of the chassis (see Figure 2-4) so that the cables will not interfere with the insertion or removal of the blower module.

Cisco recommends using the bottom cable management bracket for managing the interface cables associated with the fiber-optic ports on node line cards (NLCs).

For additional information about cable routing requirements within your site, consult the document *GR-63-CORE, Network Equipment-Building System (NEBS) Requirements: Physical Protection.*

For instructions on how to remove the top cable management bracket to service the blower module, refer to the *Cisco 6400 Hardware Installation and Maintenance Guide.*

Integrity of Chassis Enclosure

The Cisco 6400 is designed to operate with all circuit boards, slot filler panels, covers, and components in place and securely attached. When thus secured, an enclosure is formed that accomplishes the following:

- Limits access to hazardous voltages and currents inside the chassis
- Confines electromagnetic interference (EMI) within the chassis
- Helps maintain the proper flow of cooling air through the chassis

Air flow disturbances within the chassis can cause thermal overloading of electronic components and induce system failures.

Caution Do not operate the Cisco 6400 without securing all line cards, bulkheads, slot filler panels, covers, and components to the chassis. You should operate the system so as to limit access to hazardous voltages and currents, prevent EMI radiation outside the chassis, and maintain the flow of cooling air through the chassis.

Cabling Requirements

This section outlines the cabling requirements for your Cisco 6400.

Before installing the Cisco 6400, you should have all interface cables and any additional required interface equipment on hand.

If you intend to build your own interface cables, you can refer to the cable pinouts detailed in Appendix B, “Cabling Specifications.”

Determining Cable Distances

The extent of your network and the distances between network interface connections depend in part on the following factors:

- Signal type
- Signal speed

- Transmission medium

The distance and rate limits referenced in the following sections are the IEEE-recommended maximum speeds and distances for signaling purposes. You should use this information as a guideline in planning your network connections *prior to* Cisco 6400 installation.

Setting Up Ethernet and Fast Ethernet Connections

The maximum distances for Ethernet and Fast Ethernet network segments and connections depend on the type of transmission cable being used. The terms *10BaseT* and *100BaseT* are industry shorthand nomenclature for the following:

- 10 Mbps transmission rate (*10*), or 100Mbps transmission rate (*100*)
- Using baseband technology (*Base*)
- By means of twisted pair wires (*T*)

Table 2-9 shows the maximum transmission distances between stations for Ethernet and Fast Ethernet connections.

Table 2-9 Ethernet and Fast Ethernet Maximum Transmission Distances

Transceiver Speed	Cable Type	Transmission Mode	Maximum Distance between Stations
10 Mbps	Category 3	Full and half duplex	328 feet (100 meters)
100 Mbps	Category 5	Full and half duplex	328 feet (100 meters)

Setting Up Fiber-Optic Connections

The specifications for single-mode, fiber-optic transmissions are outlined in Table 2-10 and Table 2-11.

Table 2-10 OC-3 Fiber-Optic Transmission Characteristics

Characteristic	Permissible Value
Transmitter output power	–14 to –8 dBm
Receiver sensitivity	–32.5 to –8 dBm
Wavelength	1261 to 1360 nm
Maximum span	9 miles (14.5 km)

Table 2-11 OC-12 Fiber-Optic Transmission Characteristics

Characteristic	Permissible Value
Transmitter output power	–15 to –8 dBm
Receiver sensitivity	–28 to –8 dBm
Wavelength	1261 to 1360 nm
Maximum span	9 miles (14.5 km)

Estimating the Power Budget

Statistical models can determine the power budget more accurately than the worst-case method. Determining the link loss with statistical methods requires accurate knowledge of variations in the data link components.

Statistical power budget analysis is beyond the scope of this publication. For further information about estimating the power budget, you can refer to the following:

- User-Network Interface (UNI) Forum specifications
- ITU-T standards
- Equipment specifications

Note The International Telecommunications Union Telecommunications Standardization Sector (ITU-T) carries out the functions of the former Consultative Committee for International Telegraph and Telephone (CCITT).

Refer to the following publications for more information on determining attenuation and power budget:

- T1E1.2/92-020R2 ANSI, the Draft American National Standard for Telecommunications entitled Broadband ISDN Customer Installation Interfaces: Physical Layer Specification
- AT&T Technical Note, TN89-004LWP, Power Margin Analysis

Approximating the Module Power Margin

In a worst-case estimate of power margin (PM) for single-mode transmissions, the following assumptions are made:

- Minimum transmitter power (PT)
- Maximum link loss (LL)
- Minimum receiver sensitivity (PR)

The worst-case analysis provides a margin of error, although not all parts of an actual system will operate at worst-case levels.

The power budget (PB) is the maximum possible amount of power transmitted. The following shows the power budget calculations:

PB = PT – PR

PB = – 14 dBm – 32.5 dBm

PB = 18.5 dB

The power margin is equal to the power budget, minus the link loss:

PM = PB – LL

When the power margin is calculated, the result should be greater than zero to ensure that the link will work. A result of less than zero indicates that there is not enough power to operate the receiver.

Table 2-12 lists the factors that contribute to link loss and the estimate of the link-loss value attributable to each factor.

Table 2-12 Estimating Link Loss

Link Loss Factor	Estimate of Link Loss Value
Connector	0.5 dB
Splice	0.5 dB
Fiber attenuation	0.5 dB/km

Table 2-13 lists the link attenuation and dispersion limit for a typical fiber-optic link.

Table 2-13 Typical Fiber-Optic Link Attenuation and Dispersion Limits

Characteristic	Single-Mode Fiber
Attenuation	0.5 dB
Dispersion limit	No limit

Single-Mode Power Budgeting

The power budget (PB) for single-mode, fiber optic transmission is equal to the maximum possible amount of power transmitted.

Below is an example of single-mode, power budget calculations with sufficient power for transmission, based on the following variables:

- Length of single-mode link is 12 kilometers (km)
- Eight connectors
- Three splices

Given these variables, you can estimate the power margin as follows:

PM = PB – LL

PM = 18.5 dB – 12 km (0.5 dB/km) – 8 (0.5 dB) – 3 (0.5 dB)

PM = 18.5 dB – 6 dB – 4 dB – 1.5 dB

PM = 7.0 dB

The 7.0 dB value indicates that this link would have sufficient power for transmission.

Setting Up Serial Connections

Serial signals travel a limited distance at any given baud rate—the slower the baud rate, the greater the distance of the connection.

Table 2-14 shows the relationship between the baud rate and the distance of EIA/TIA-232 signals.

Table 2-14 Baud Rate Versus Transmission Distance

Baud Rate (bps)	Distance (feet)	Distance (meters)
2400	200	60
4800	100	30

Table 2-14 Baud Rate Versus Transmission Distance

Baud Rate (bps)	Distance (feet)	Distance (meters)
9600	50	15
19,200	25	7.6
38,400	12	3.7
56,000	8.6	2.6

System Grounding Requirements

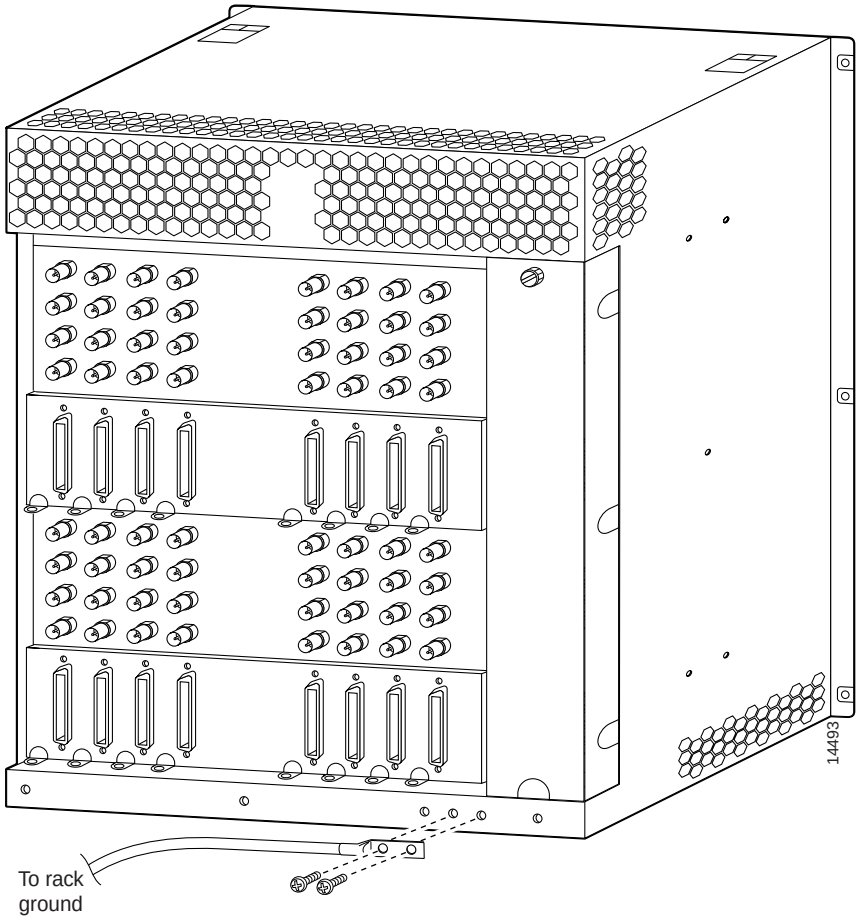
The bottom rear edge of the Cisco 6400 enclosure (see Figure 2-5) contains six threaded holes that are used as follows:

- The rightmost threaded hole is used for attaching a jumper ground wire between the optional AC power shelf and the Cisco 6400 chassis. This is a single-hole grounding lug.
- The second and third threaded holes from the right provide a system grounding connection for the Cisco 6400. These holes accommodate a 2-hole lug for firmly securing the grounding wire in place and preventing it from twisting.
- The three leftmost threaded holes are used to attach the safety cover of the optional AC power shelf to the Cisco 6400 chassis.
- The AC PEM includes the safety ground in the AC cable. Additional facility grounds may be added to the rear 2-hole lug as required for the site grounding plan. (See .)

You should complete this grounding connection before applying power to the Cisco 6400.

Note The Cisco 6400 is compatible with customer sites that use either isolated or common bonding networks.

Figure 2-5 System Grounding Holes on the Cisco 6400 Enclosure



Safety Guidelines

This section alerts you to important safety and operating precautions that you should keep in mind during the installation and operation of your Cisco 6400.

Lifting Precautions

A Cisco 6400 chassis that is populated with two PEMs and a full complement of circuit boards weighs approximately 130 pounds (59.02 kg). You should exercise extreme care in lifting and moving the Cisco 6400.

Warning **To prevent personal injury or damage to the chassis, never attempt to lift or tilt the chassis using the handles on modules (such as power supplies, fans, or cards); these types of handles are not designed to support the weight of the unit. Lift the unit only by using handles that are an integral part of the chassis, or by grasping the chassis underneath the lower edge.**

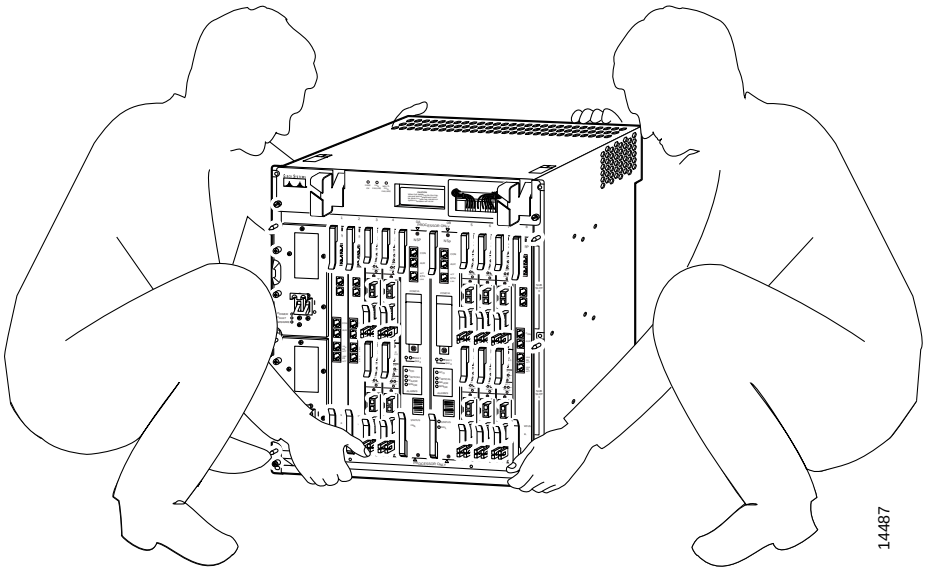
Warning **Two people are required to lift the chassis. To prevent injury, keep your back straight and lift with your legs, not your back.**

Cisco recommends that two individuals lift the Cisco 6400 when it is to be moved within your site or to be installed in an equipment rack. Figure 2-6 illustrates the proper lifting techniques for handling the Cisco 6400.

In grasping the Cisco 6400 from the front, you should first remove the bottom cable management bracket (if present), remove the air filter assembly (if present), and insert your hand into the air intake opening.

In grasping the rear of the Cisco 6400, you should place your other hand beneath the exhaust vent at the top rear of the enclosure to support the weight of the chassis.

Figure 2-6 Proper Lifting Techniques for Handling the Cisco 6400



Operating Precautions

Keep the following precautions in mind when you plan equipment locations, perform system maintenance, or remove/install Cisco 6400 components:

- The Cisco 6400 environmental monitor continuously checks the interior environment of the Cisco 6400 and provides warnings for high temperature conditions.

  If warning messages are displayed, take immediate action to identify the cause and correct the problem. Use the **show environment** command regularly on the NSP to check the internal status of the Cisco 6400.

- Keep the front of the Cisco 6400 free from obstructions and away from the exhaust air of other installed equipment.

  Electrical equipment generates heat, and ambient room temperature alone might not be sufficient to keep equipment within acceptable operating temperatures.

- Follow proper electrostatic discharge (ESD) prevention procedures when you are installing and/or removing Cisco 6400 components.

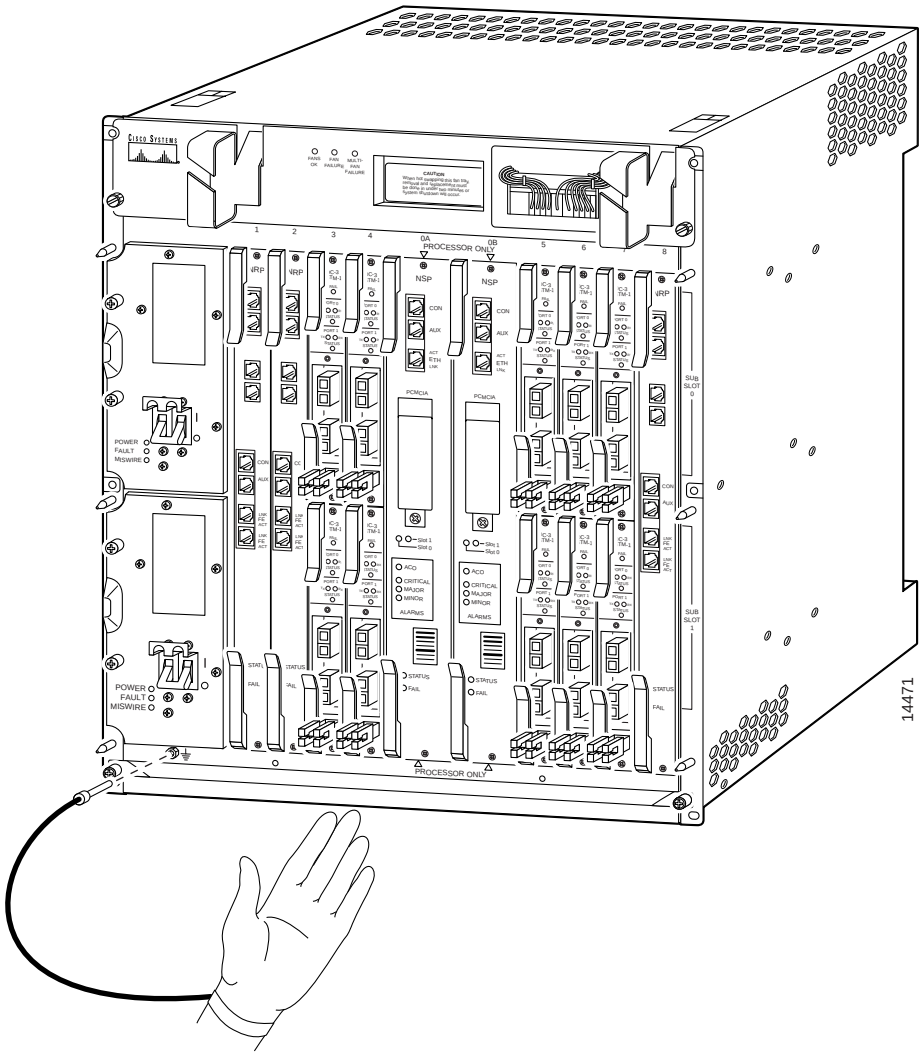
To prevent ESD damage to Cisco 6400 components, always wear an ESD wrist strap connected to the ESD socket on the front of the Cisco 6400 when you are installing or removing circuit boards. (See Figure 2-7.)

The discharge of static electricity during the handling of Cisco 6400 circuit boards can cause immediate or intermittent system failure.

- Ensure that chassis panels, circuit boards, and slot filler panels are in place, seated firmly, and secured.

  The fan assembly directs cooling air throughout the interior of the Cisco 6400. An unsecured or missing slot filler panel can cause cooling air to be misdirected, reducing the flow of cooling air across installed circuit boards.

Figure 2-7 Using an ESD Wrist Strap



System Ventilation Precautions

When installing the Cisco 6400 in an equipment rack, you should observe the following precautions to avoid internal overtemperature conditions:

- Install the chassis in an enclosed rack only if the rack has adequate ventilation or an exhaust fan. Whenever possible, use an open rack for installing the Cisco 6400.
- A ventilation system for a closed rack that is too powerful may prevent adequate cooling of the Cisco 6400 by creating negative pressure and redirecting the airflow away from the air intake at the bottom front of the chassis. If possible, operate the Cisco 6400 using an open rack.
- The use of baffles inside an enclosed rack can help keep the Cisco 6400 cool.
- Equipment near the bottom of a rack may generate excessive heat that can rise into the equipment above, potentially causing overtemperature conditions in such equipment.