Cisco CRS Carrier Routing System 16-Slot Line Card Chassis Enhanced Router Site Planning Guide

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Preface

This preface explains the objectives, intended audience, and organization of this *Cisco CRS Carrier Routing System 16-Slot Line Card Chassis Enhanced Router Site Planning Guide*, referred to in this document as the site planning guide , and describes the conventions used in the document.

Objective

This guide describes the basic facility requirements, such as floor space, power requirements, and environmental requirements, for the Cisco CRS Series 16-Slot Line Card Chassis Enhanced. This guide is intended to help you plan the sites where the chassis will be installed. It should be used with Cisco site planning coordinators and site inspectors, well in advance of the delivery of the chassis.

Audience

This guide is intended for anyone who plans the facilities, including space, floor weighting, power, cooling, cabling, delivery, and storage, for the installation of a Cisco CRS 16-Slot LCC Enhanced router.

Document Organization

This guide contains the following chapters and appendixes:

- Cisco CRS Carrier Routing System 16-Slot Line Card Chassis Enhanced Router Overview, on page 1 describes the Cisco CRS routing system.

- Space Planning, on page 17 provides information about chassis space requirements and other site preparation details (for example, floor loading and securing the chassis to the floor).
- Power and Cooling Requirements, on page 25 describes the power and cooling requirements for the chassis.
- Shipping and Receiving, on page 43 describes the things to consider as you plan for the shipment of the chassis and transport to the installation site.
- System Planning Considerations, on page 53 provides information about system planning considerations.
- Product IDs, on page 57 provides the product identifiers (IDs) for orderable chassis components.
- Preliminary Site Survey, on page 71 contains a sample preliminary site survey in which to enter information about the installation site and site-preparation process.
- System Specifications, on page 77 lists the chassis specifications.

Documentation Conventions

This document uses the following conventions:

Convention	Description
bold font	Commands and keywords and user-entered text appear in **bold** font.
Italic font	Document titles, new or emphasized terms, and arguments for which you supply values are in *italic* font.
[ ]	Elements in square brackets are optional.
{x | y | z}	Required alternative keywords are grouped in braces and separated by vertical bars.
[x | y | z]	Optional alternative keywords are grouped in brackets and separated by vertical bars.
string	A nonquoted set of characters. Do not use quotation marks around the string or the string will include the quotation marks.
`courier` font	Terminal sessions and information the system displays appear in `courier` font.
	Indicates a variable for which you supply values, in context where italics cannot be used.
< >	Nonprinting characters such as passwords are in angle brackets.
[ ]	Default responses to system prompts are in square brackets.
!, #	An exclamation point (!) or a pound sign (#) at the beginning of a line of code indicates a comment line.

Note *Means reader take note*. Notes contain helpful suggestions or references to material not covered in the manual.

Tip *Means the following information will help you solve a problem*. The tips information might not be troubleshooting or even an action, but could be useful information, similar to a Timesaver.

Caution *Means reader be careful*. In this situation, you might perform an action that could result in equipment damage or loss of data.

Warning IMPORTANT SAFETY INSTRUCTIONS

This warning symbol means danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. Use the statement number provided at the end of each warning to locate its translation in the translated safety warnings that accompanied this device.

SAVE THESE INSTRUCTIONS

Warning Statements using this symbol are provided for additional information and to comply with regulatory and customer requirements.

Related Cisco CRS Documentation

For a complete listing of planning, installation, and configuration documents, see the following publications:

- Cisco CRS Carrier Routing System 16-Slot Line Card Chassis Enhanced Router Installation Guide
- Cisco CRS Carrier Routing System 16-Slot Line Card Chassis Enhanced Router System Description
- Cisco Carrier Routing System 16-Slot Line Card Chassis Enhanced Router Unpacking, Moving, and Securing Guide
- Cisco CRS 3-Phase AC Power Distribution Unit Installation Guide
- Cisco CRS Fiber-Optic Cleaning Kit Quick Start Guide
- Cisco CRS Carrier Routing System Hardware Documentation Guide
- Cisco CRS Carrier Routing System Regulatory Compliance and Safety Information
- Cisco CRS Carrier Routing System Ethernet Physical Layer Interface Module Installation Note
- Cisco CRS Carrier Routing System Packet-over-SONET/SDH Physical Layer Interface Module Installation Note

Changes to This Document

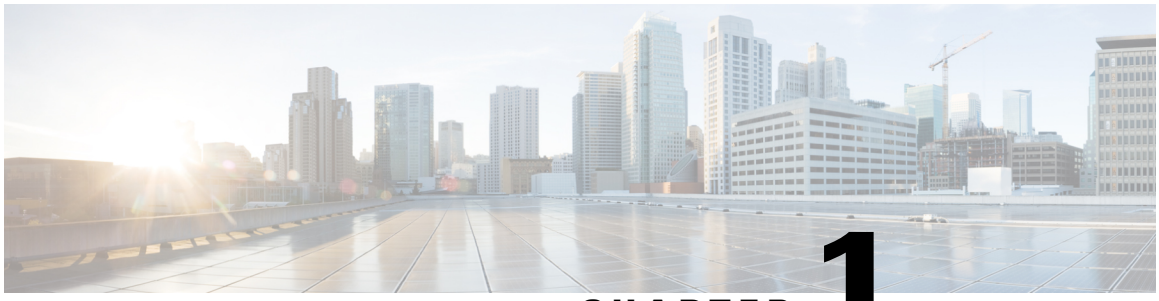
Table 1: Changes to This Document

Date	Change Summary
July 2014	Added support for new 2x100GE-FLEX-40 PLIM. Added updates to support the Cisco CRS-X 400G back-to-back and multishelf systems, which include new CRS-16-FC400/M switch fabric cards.
January 2014	Added updates to support the Cisco CRS-X, which includes new line cards, switch fabric cards, and PLIMs.
May 2012	Minor text, illustration, and specification updates.
October 2011	Initial release of this document. This document introduces the Cisco CRS 16-Slot Line Card Chassis Enhanced router. The Cisco CRS 16-Slot Line Card Chassis Enhanced router includes the following new features: • The mid-plane on the Cisco CRS 16-Slot Line Card Chassis Enhanced router is redesigned to support 400G per slot. • A new reduced height Power Shelf has been introduced for the Cisco CRS 16-Slot Line Card Chassis Enhanced router, which results in larger space for air intake (at the bottom of the chassis). This increases the overall cooling efficiency of the chassis. • A new Alarm Card has been introduced for the Cisco CRS 16-Slot Line Card Chassis Enhanced router that is designed to fit in the new reduced height Power Shelf. • The Cisco CRS 16-Slot Line Card Chassis Enhanced router Fan Controller monitors and controls nine cooling fans per fan tray using Pulse Width Modulation (PWM). This new Pulse Width Modulation (PWM) controlled Fan Tray gets power directly from the mid-plane. The Cisco CRS 16-Slot Line Card Chassis router used Voltage Controlled Fan Trays. • The Cisco CRS 16-Slot Line Card Chassis enhanced router removes the zone circuit breaker and power-zoning requirement.

Obtaining Documentation and Submitting a Service Request

For information on obtaining documentation, using the Cisco Bug Search Tool (BST), submitting a service request, and gathering additional information, see *What's New in Cisco Product Documentation*, at: http://www.cisco.com/c/en/us/td/docs/general/whatsnew/whatsnew.html.

Subscribe to *What's New in Cisco Product Documentation*, which lists all new and revised Cisco technical documentation as an RSS feed and delivers content directly to your desktop using a reader application. The RSS feeds are a free service.



CHAPTER 1

Cisco CRS Carrier Routing System 16-Slot Line Card Chassis Enhanced Router Overview

This chapter provides an overview of the Cisco CRS Carrier Routing System 16-Slot Line Card Chassis Enhanced Router, referred to as LCC in this document. It contains the following sections:

Overview

The 16 slots in the LCC can contain the following:

- Modular services cards (MSCs)
- Forwarding processor (FPs) cards
- Label switch processor (LSP) cards

Note MSCs, FPs, and LSPs are referred to as line cards.

- Associated physical layer interface modules (PLIMs)
- SPA Interface Processors (SIPs)

Each slot has the capacity of up to 400 gigabits per second (Gbps) ingress and 400 Gbps egress, for a total routing capacity per chassis of 12800 Gbps or 12.8 terabits per second (Tbps). (A terabit is 1 x 1012 bits or 1000 gigabits.)

The LCC supports 40G, 140G, and 400G fabric cards, as follows:

- The Cisco CRS-1 Carrier Routing System uses fabric cards designed for 40 G operation (CRS-16-FC/S or CRS-16-FC/M cards).
- The Cisco CRS-3 Carrier Routing System uses fabric cards designed for 140G operation (CRS-16-FC140/S or CRS-16-FC140/M cards).
- The Cisco CRS-X Carrier Routing System uses fabric cards designed for 400G operation (CRS-16-FC400/S or CRS-16-FC400/M cards).

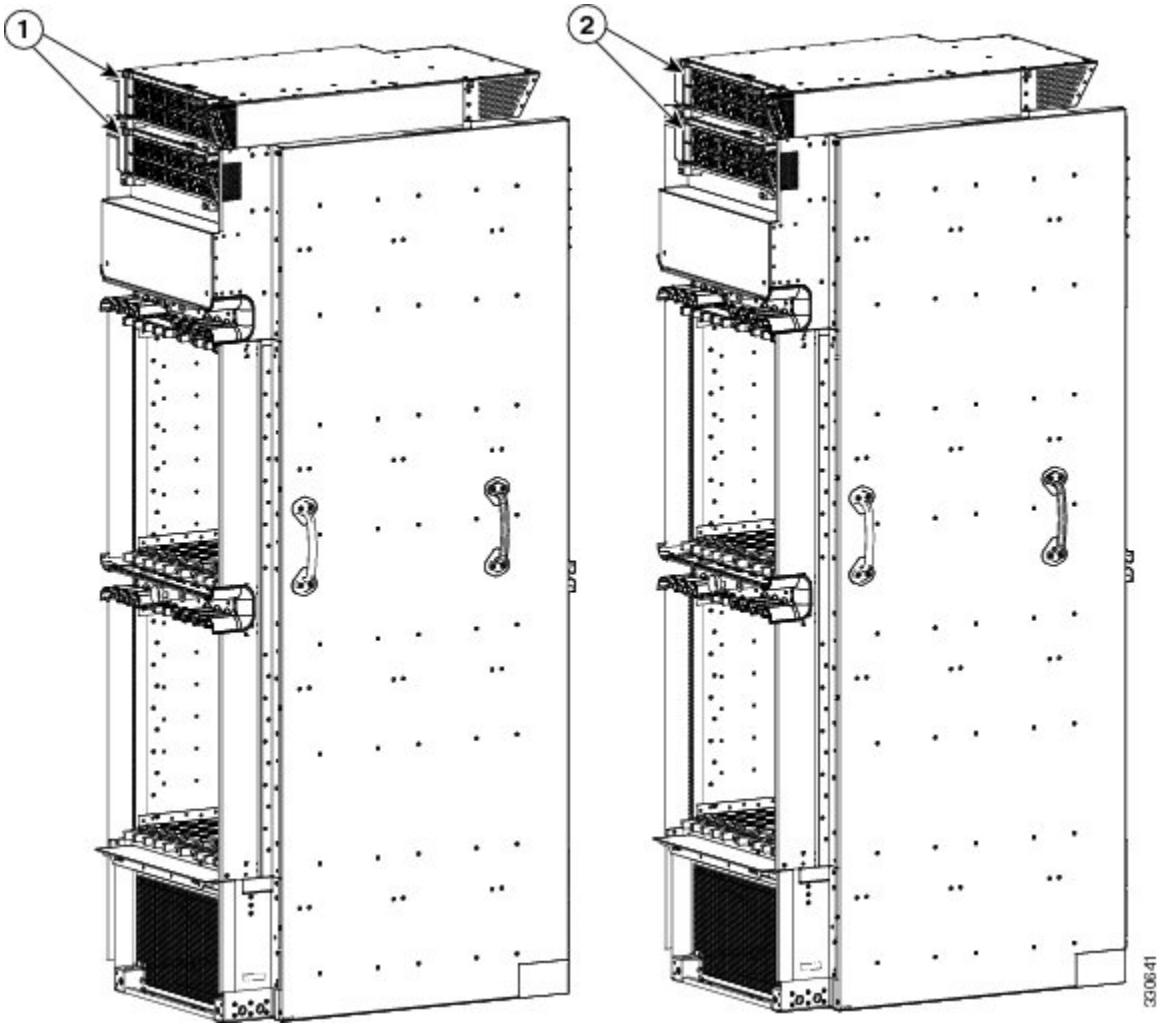
A mixture of 40G, 140G, and 400G fabric cards is not supported except during migration.

Note Throughout this document, the generic term Cisco CRS Carrier Routing system refers to the Cisco CRS-1, Cisco CRS-3, and Cisco CRS-X Carrier Routing Systems, unless otherwise specified.

The chassis has an integrated rack and does not require an external rack. It is bolted to the facility floor. It contains its own power and cooling systems. Power systems are available using AC or DC power.

The following figure shows the front view of the LCC with AC and DC power shelves installed.

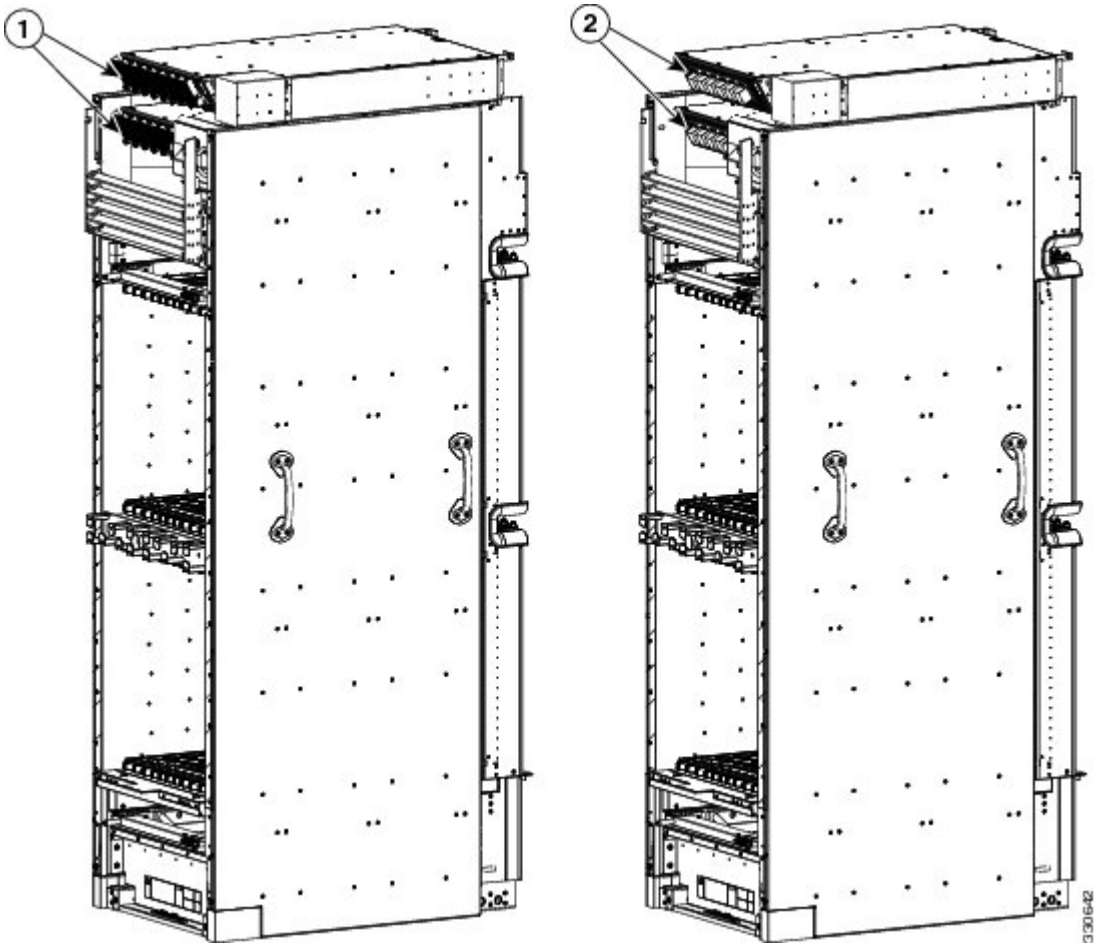
Figure 1: LCC Front (PLIM) Side View



1	DC power shelves (two installed)	2	AC power shelves (two installed)

The following figure shows the rear view of the LCC.

Figure 2: Line Card Chassis Rear (MSC) Side View



1	DC power shelves (two installed)	2	AC power shelves (two installed)

Line Card Chassis Components

This section lists the main components of the LCC. It primarily identifies the components that are considered field-replaceable units (FRUs), but where additional detail is useful, identifies subassemblies that are not field replaceable.

The line card chassis contains:

- As many as 16 MSCs, FPs, LSPs (all referred to as line cards) and associated PLIMs and SIPs/SPAs. A line card and a PLIM or SIP/SPA are an associated pair of cards that connect through the chassis midplane. The line card provides the forwarding engine for Layer 3 routing of user data that is switched

through the system, and the PLIM or SIP/SPA provides the physical interface and connectors for the user data.

Note For a complete list of available PLIMs, consult your Cisco sales representative or visit: http://www.cisco.com

- ◦ The MSC card is available in the following versions: CRS-MSC (end-of-sale), CRS-MSC-B, CRS-MSC-140G, and CRS-MSC-X (400G mode).
  - ◦ The FP card is available in the following versions: CRS-FP140, CRS-FP-X (400G mode).
  - ◦ The LSP card is available in the following versions: CRS-LSP, CRS-LSP-X.
- Each line card can be associated with different types of PLIMs, which provide different interface speeds and technologies. Note the following:
  - ◦ The CRS-MSC-B card is compatible with both 40G CRS-1 and 140G CRS-3 fabric cards.
  - ◦ The CRS-MSC-140G card is only compatible with the 140G CRS-3 fabric card.
  - ◦ The CRS-MSC-X card is only compatible with the 400G CRS-X fabric card.
- Chassis midplane. The midplane connects a line card to its associated PLIM. The midplane design allows the line card to be removed from the chassis without having to disconnect the cables that are attached to the associated PLIM. The midplane, which also distributes power, connects the line cards to the switch fabric cards, and provides control plane interconnections, is not field replaceable by the customer.
- Two route processor cards (RPs). The RPs provide the intelligence of the system by functioning as the chassis system controller. There are two types: RP and Performance Route Processor (PRP).

Note A chassis may not be populated with a mix of RP and PRP cards. Both route processor cards should be of the same type (RP or PRP).

- Eight switch fabric cards. These fabric cards provide a three-stage Benes switch fabric for the system.
  - ◦ As a single-shelf (standalone) system, the line card chassis contains S123 switch fabric cards that provide all three stages of the three-stage Benes switch fabric.
  - ◦ As part of a multishelf system, the LCC contains S13 fabric cards that provide stage 1 and stage 3 of the switch fabric. S2 fabric cards in the FCCs provide stage 2 of the fabric, and fabric cables connect the fabric cards to each other.

Note The LCC supports either 40G fabric cards (FC/S cards), 140G fabric cards (FC-140/S cards), or 400G fabric cards (FC-400/S cards). An LCC with a mix of 40G, 140G, and 400G fabric cards is not a supported mode of operation. Such a mode is temporarily allowed only during the upgrade process.

- A power system that provides redundant power to the chassis. Two types of power systems are available: either AC or DC power.

- Two alarm modules. The alarm modules provide external alarm system connections. The alarm modules are located in the AC or DC power shelves.
- Upper and lower fan trays. The trays push and pull air through the chassis. A removable air filter is located above the lower fan tray.
- Two fan controller cards. The cards control the speed of high-speed fans in the fan trays to adjust the airflow for ambient conditions.
- Front and rear cable management features. The front (PLIM) side of the chassis has horizontal cable management brackets above both card cages. The rear (MSC) side of the chassis has one cable management bracket located in the middle of the chassis above the lower card cage.

Main Features of the Cisco CRS Series Carrier Routing System

The main features of all Cisco CRS Series routing systems include:

- A highly scalable router that provides a routing capacity between 1.28 and 12.8 Tbps.
- A wide range of interface speeds and types (for example, OC-48 packet-over-SONET or POS) and OC-192 POS), and a programmable MSC or FP forwarding engine that provides full-featured forwarding at line-rate speeds.
- Redundancy and reliability features allow nonstop operation even during service upgrades of equipment, with no single points of failure in hardware or software.
- Potential for expanding from single-chassis to multichassis (or multishelf) systems.
- Partitioning into logical routers. A logical router (LR) is a set of MSCs or FPs and route processors (RPs) that form a complete router. More specifically, each LR contains its own instance of dynamic routing, IP stack, SysDB (system database), interface manager, event notification system, and so on.

Chassis Overview

This section provides an overview of the physical chassis characteristics:

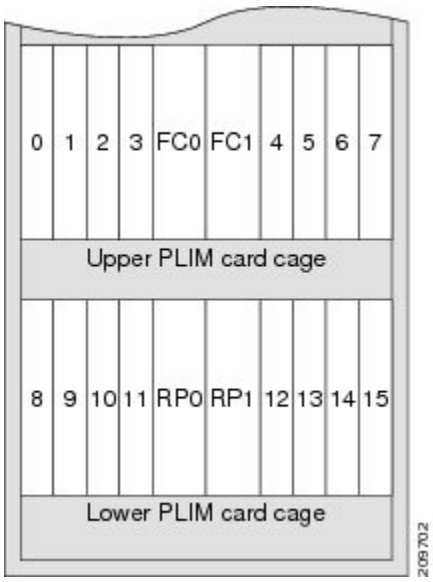
Slot Numbers

A single-shelf (standalone) system consists of a single LCC. A multishelf system includes up to nine LCCs and connects up to four switch fabric card chassis.

This section identifies the locations of and slot numbers for major cards that plug into the chassis.

The following figure shows the chassis slot numbers on the PLIM side of the LCC.

Figure 3: Line Card Chassis Front (PLIM) Side Slot Numbers

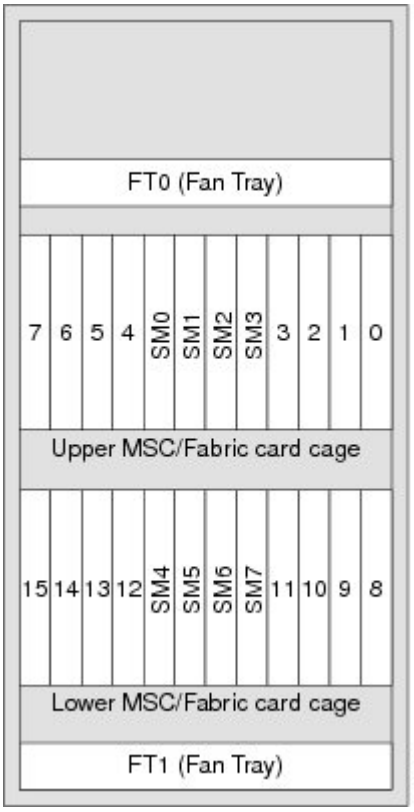


As shown in the figure, the components on the front (PLIM) side of the chassis include:

- Upper PLIM card cage with eight PLIM slots (left to right: 0, 1, 2, 3, 4, 5, 6, 7) spaced around two double-width fan controller card slots, FC0 and FC1. (These thicker-width slots accept only the two fan controllers.)
- Lower PLIM card cage with eight PLIM slots (left to right: 8, 9, 10, 11, 12, 13, 14, 15) and two double-width route processor card slots, RP0 and RP1. (These thicker-width slots accept only the RPs.)

The following figure shows the chassis slot numbers on the rear (MSC) side of the LCC.

Figure 4: Rear (MSC) Side Slot Numbers



As shown in the figure, the components on the rear (MSC) side of the chassis include:

- Upper fan tray (FT0)
- Upper card cage, eight MSC slots (left to right: 7, 6, 5, 4, 3, 2, 1, 0) spaced around four switch fabric card slots (SM0, SM1, SM2, and SM3)
- Lower card cage, eight MSC slots (left to right: 15, 14, 13, 12, 11, 10, 9, 8) spaced around four switch fabric card slots (SM4, SM5, SM6, and SM7)
- Lower fan tray (FT1)

The MSC slot numbers on the rear of the chassis are reversed from the PLIM slot numbers on the front side of the chassis. A mated MSC and PLIM are slot specific and mated through the midplane. The MSC slot 0, on the far right side of the chassis looking at it from the rear (MSC) side, is mated with the PLIM slot 0, on the far left side of the chassis looking at it from the front (PLIM) side. All other MSC and PLIM slots (2 through 15) are mated via matching slot numbers through the midplane also.

Chassis Cable Management

The LCC has cable management features for both the front (PLIM) and rear (MSC) sides of the chassis. The PLIM side has horizontal cable management features above both card cages. The horizontal cable management

trays have a special telescoping feature that allows them to be extended when the chassis is upgraded with higher-density cards. This extension feature also helps when installing the cables in the chassis. Ensure that the horizontal cable management trays are pushed in before closing the front door.

There are two types of vertical cable troughs as part of the chassis cable management: standard width and wider width.

The MSC side of the chassis has one cable management system above the lower card cage (in the middle of the chassis). These cable management trays are not telescoping because there is a preset amount of fiber cabling to be managed.

Chassis Exterior Components

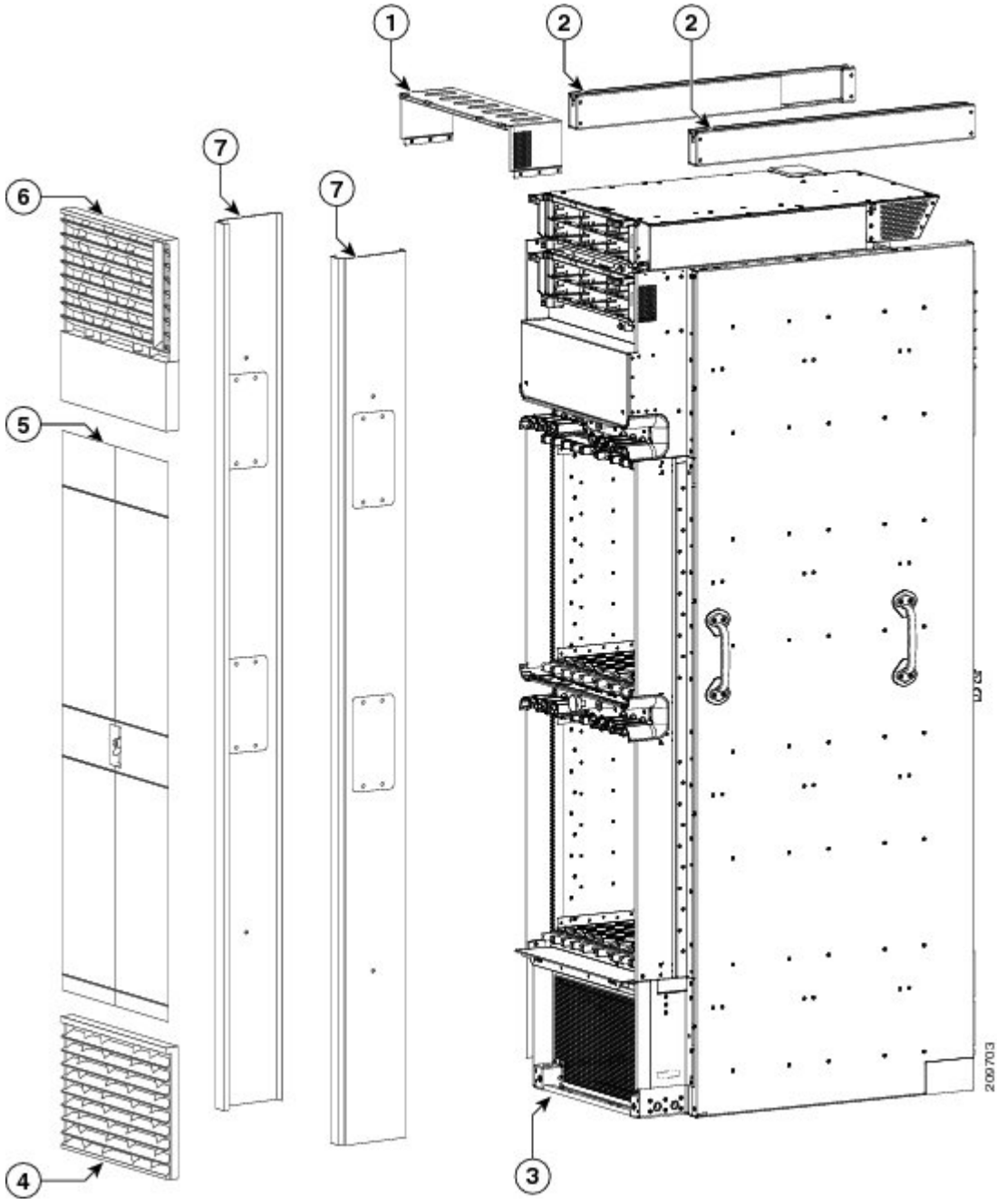
This section contains information about the exterior cosmetic components.

The LCC is shipped with exterior cosmetic components for the front (PLIM) side and rear (MSC) side of the chassis.

Note Some exterior cosmetic components are not required to be installed.

The following figure shows the exterior cosmetics for the front (PLIM) side of a chassis.

Figure 5: Front (PLIM) Side Exterior Cosmetic Components

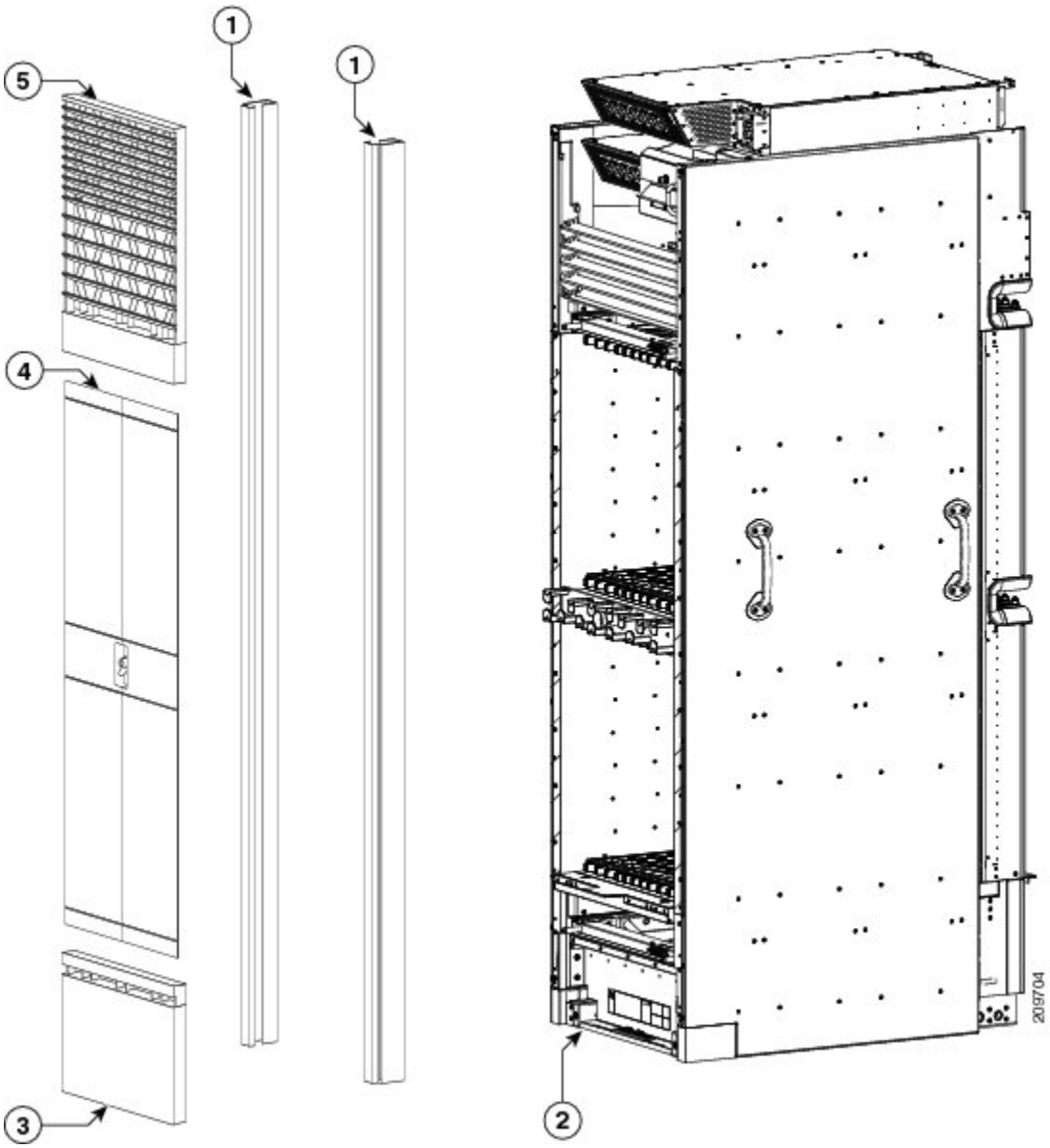


1	Upper grille support	5	Doors
2	Unistruts	6	Upper grille

3	Bracket for lower grille	7	Vertical cable troughs
4	Lower grille		

The following figure shows the exterior cosmetics on the rear (MSC) side of the LCC.

Figure 6: Rear (MSC) Side Exterior Cosmetic Components

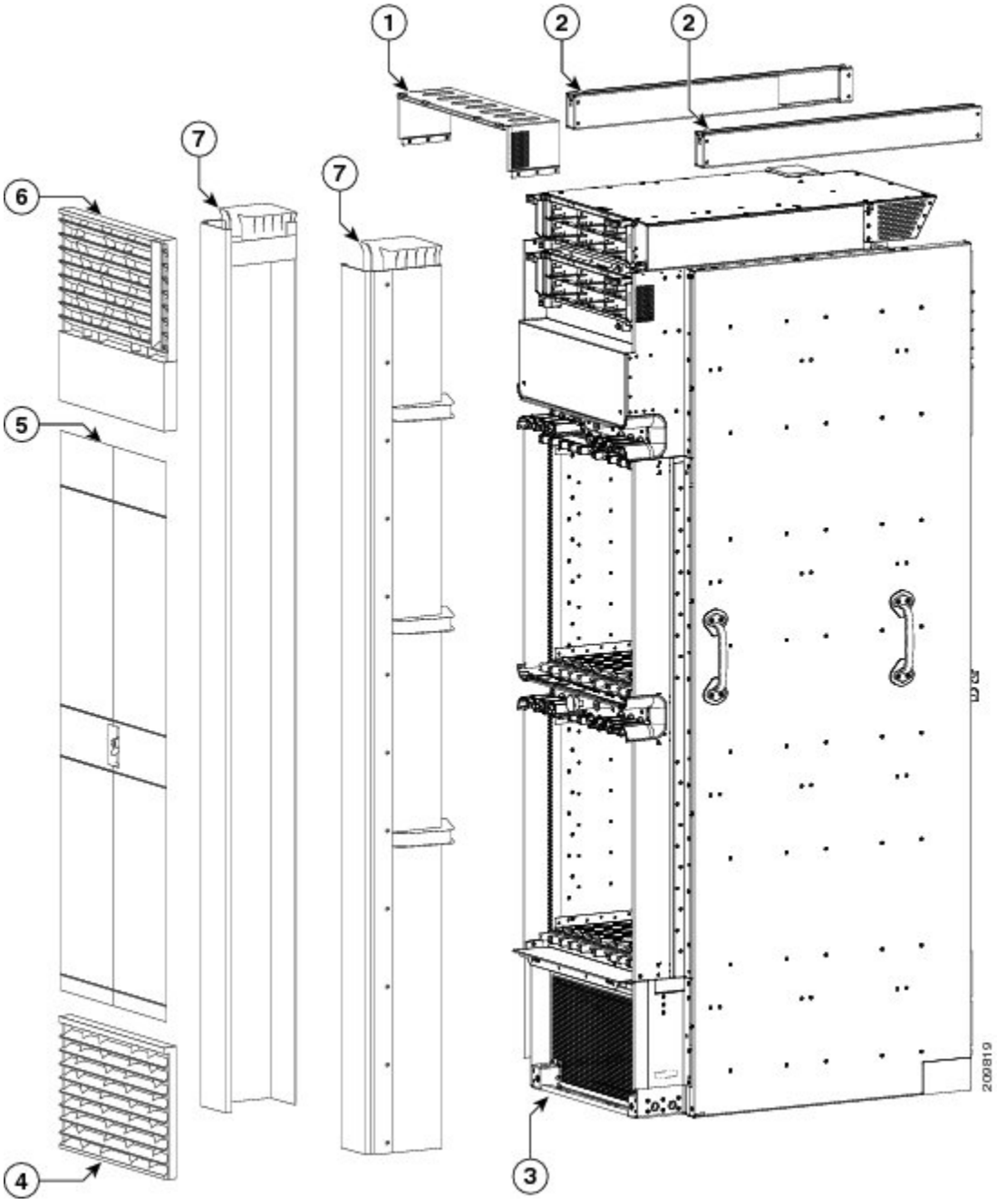


1	Vertical cable troughs	4	Doors

2	Bracket for optional rear kick panel	5	Upper air grille
3	Rear kick panel (optional, orderable separately)		

The following figure shows the exterior cosmetics for the front (PLIM) side of an optional wide duct system.

Figure 7: Front (PLIM) Side Exterior Cosmetic Components—Optional Wide Duct System



1	Upper grille support	5	Doors
2	Unistruts	6	Upper grille

3	Bracket for lower grille	7	Wide vertical cable troughs
4	Lower grille		

Safety Guidelines

Before you perform any LCC installation procedures, review the safety guidelines in this section to avoid injuring yourself or damaging the equipment.

Note Although power shelves may be installed or removed without powering down the system, for safety purposes we recommend that you power down the system before you install or remove a power shelf.

The following guidelines are for your safety and to protect equipment. The guidelines do not include all hazards. Be alert.

Note Review the safety warnings listed in *Regulatory Compliance and Safety Information for the Cisco CRS Carrier Routing System* before installing, configuring, or troubleshooting any installed card.

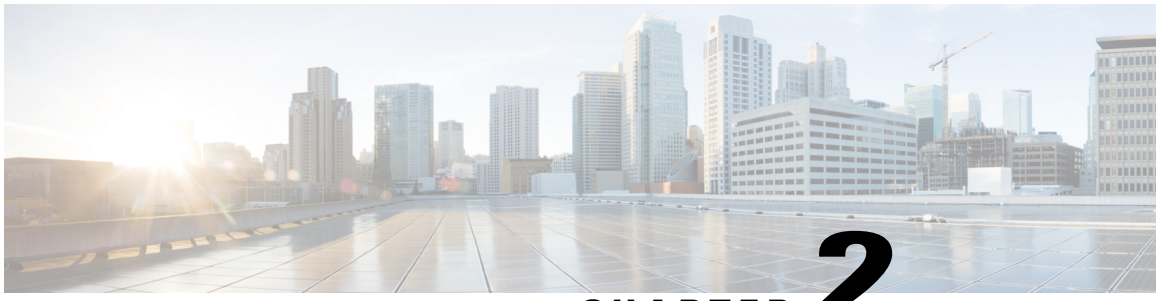
- Never attempt to lift an object that might be too heavy for you to lift by yourself.
- Keep the work area clear and dust free during and after installation. Do not allow dirt or debris to enter into any laser-based components.
- Keep tools and router components away from walk areas.
- Do not wear loose clothing, jewelry, and other items that could get caught in the router while working with OIMs, SFCs, and their associated components.
- Use Cisco equipment in accordance with its specifications and product-usage instructions.
- Do not work alone if potentially hazardous conditions exist.
- Make sure your installation follows national and local electrical codes: in the United States, National Fire Protection Association (NFPA) 70, United States National Electrical Code; in Canada, Canadian Electrical Code, part I, CSA C22.1; in other countries, International Electrotechnical Commission (IEC) 60364, part 1 through part 7.
- Connect only a DC power source that follows the safety extra-low voltage (SELV) requirements in UL/CSA/IEC/EN 60950-1 and AS/NZS 60590 to the DC-input power system.
- Make sure that you have a readily accessible two-poled disconnect device incorporated in the fixed configuration wiring of a CRS configured with the DC-input power system.
- Make sure that you provide short-circuit (overcurrent) protection as part of the building installation.

Preventing Electrostatic Discharge

Electrostatic discharge (ESD) damage, which can occur when electronic cards or components are improperly handled, results in complete or intermittent failures. We recommend use of an ESD-preventive strap whenever you handle network equipment or one of its components.

Following are guidelines for preventing ESD damage:

- Always use an ESD-preventive wrist or ankle strap, and ensure that it makes good skin contact. Connect the equipment end of the connection cord to an ESD connection socket on the router or to a bare metal surface on the chassis.
- Handle a card by its ejector levers, when applicable, or its metal carrier only; avoid touching the board or connector pins.
- Place a removed card board side up on an antistatic surface or in a static-shielding bag. If you plan to return the component to the factory, immediately place it in a static-shielding bag.
- Avoid contact between the card and clothing. The wrist strap protects the board from only ESD voltage on the body; ESD voltage on clothing can still cause damage.



CHAPTER 2

Space Planning

This chapter provides information to help you determine where to install the Cisco CRS Series 16-Slot Line Card Chassis Enhanced router and to plan and prepare the site for the installation of the chassis. It describes the amount of space required for the chassis and provides information about floor loading and drill hole locations for securing the chassis to the floor. This chapter contains the following sections:

Basic CRS Routing System Floor Plans

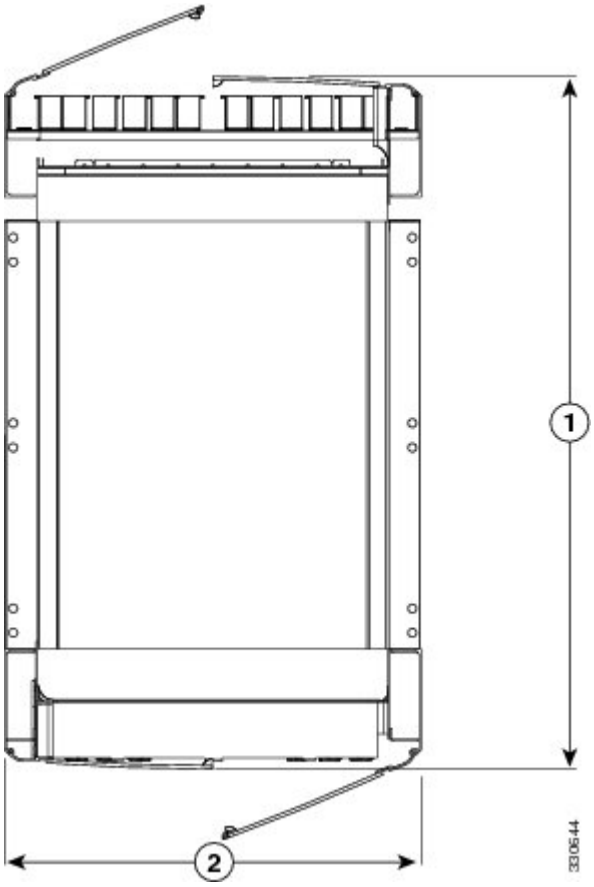
As part of the site planning process, you must decide where to install the Cisco CRS 16-Slot Line Card Chassis Enhanced router. As you consider where to install the system, consider the following:

- Installation site floor plan must include:
  - Enough free space for the chassis (see the Cisco CRS 16-Slot Line Card Chassis Enhanced Router Footprint, on page 18 section).
  - Adequate space for airflow and enough room to access chassis components for maintenance (see the Aisle Spacing and Maintenance Access Floor Plan, on page 19 section).
  - Additional free space for potential expansion of the system (see the Planning for Future Expansion, on page 23 section).
- Slab or raised floor must support the weight of the chassis at the installation site (see the Chassis Floor Loading, on page 23 section).

Cisco CRS 16-Slot Line Card Chassis Enhanced Router Footprint

The following figure is a top view of the Cisco CRS 16-Slot Line Card Chassis Enhanced router footprint (with default front and rear cosmetics installed). The rear of the chassis is at the top of the figure.

Figure 8: Top View of the Cisco CRS 16-Slot Line Card Chassis Enhanced Router—With Default Cosmetics Installed

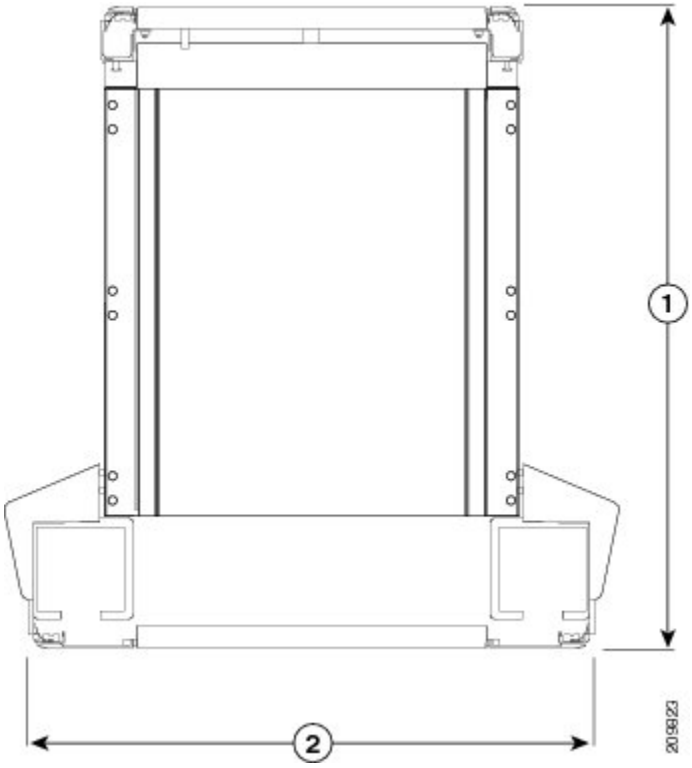


1	39.7 in. (101 cm), with front and rear doors
2	23.6 in. (60 cm), width of chassis, without handles

Note A single-shelf (single chassis) system does not require chassis interconnect cabling; therefore, the rear door is optional.

The following figure is a top view of the Cisco CRS 16-Slot Line Card Chassis Enhanced router footprint (with optional front cosmetics installed as part of a wide duct system). The rear of the chassis is at the top of the figure.

Figure 9: Top View of the Cisco CRS 16-Slot Line Card Chassis Enhanced Router—With Optional Wide Trough Front Cosmetics Installed



1	40.3 in. (102.2 cm) with wide troughs
2	31.8 in. (80.8 cm) with wide troughs

Aisle Spacing and Maintenance Access Floor Plan

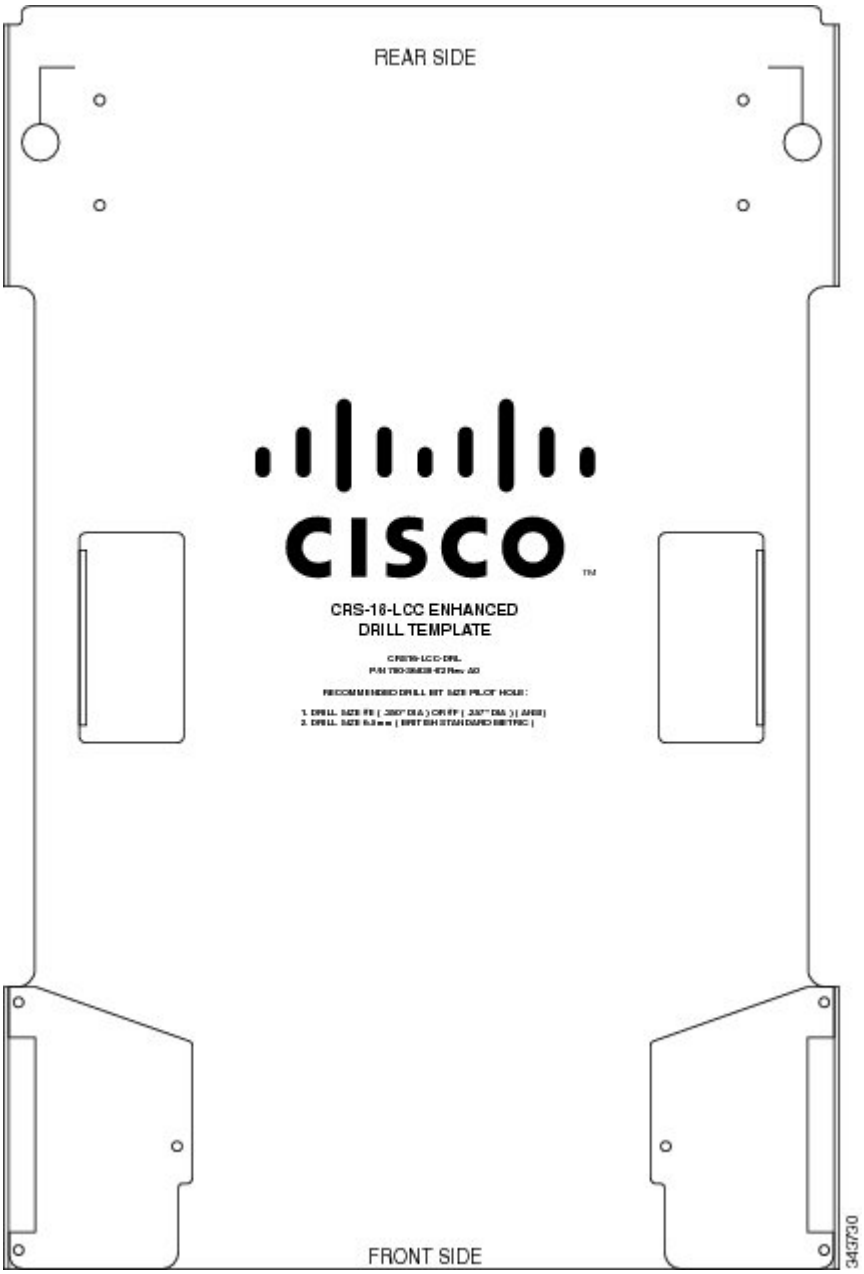
Make sure that enough space exists at the installation site to install the Cisco CRS 16-Slot Line Card Chassis Enhanced router and allow sufficient airflow. The floor plan must also provide enough room to access chassis components for maintenance (for example, to remove fan trays, power modules, cables, and air filters). We recommend 48 in. (122 cm) clearance to install the chassis and 36 in. (91 cm) clearance to allow for access to chassis components.

Cisco provides two layout templates to help you determine where to install the system:

- Aluminum plate template (CRS-16-DRILLTEMP) shows the chassis footprint and the pattern of holes that must be drilled into the floor for the mounting studs that secure the chassis to the floor. See the Anchoring the Chassis to the Floor, on page 23 section. See the following figure.

If you are configuration using standard troughs for cabling, unscrew and remove the side wings before placing and using the drill template. If you are using wide troughs, fold the side wings out and tighten to stabilize them before placing and using the drill template.

Figure 10: Cisco CRS 16-Slot Line Card Chassis Enhanced Router Drill Template



- Mylar template (CRS-16-FLOORTEMP) shows the chassis footprint, door swings, and required clearances to remove and replace chassis components. Use this template to plan the aisle space required for the installation and maintenance of a line card chassis. See the figure below.

Note For front-to-front row alignment and back-to-back row alignment, we recommend that adjacent rows of chassis align the front intake to front intake or rear exhaust to rear exhaust.

Note The template shown in the following figure is only for space planning. Do not use this template as a drill template.

Figure 11: Cisco CRS 16-Slot Line Card Chassis Enhanced Router Floor Plan Mylar Template

Planning for Future Expansion

When planning the installation of the Cisco CRS Series system, consider potential expansion of the system, such as adding additional Cisco CRS 16-Slot Line Card Chassis Enhanced routers (single-shelf or multishelf system).

When planning for expansion, consider:

- Floor space for additional chassis or multishelf growth LCC to FCC
- Power and cooling requirements for additional chassis
- Cable management for additional interconnection cables and line card interface cables
- System management for the larger systems

Chassis Floor Loading

Whether you plan to install the chassis on slab concrete or raised floors, ensure that the floor is level and that it can support the weight of the chassis. See System Specifications, on page 77 for specifications on chassis weight and floor loading.

If you have 3-phase AC Delta or AC Wye at your site, a Cisco CRS 3-phase AC power distribution unit (PDU) will be required to convert 3-phase AC input power to single-phase AC input power for the power shelf. The following table lists the weight of the PDUs required to be installed for system redundancy, including cables and chassis-mounting brackets.

Table 2: Power Distribution Unit Weight

PDU Type	Weight
CRS-16 PDU (including two PDUs, cables and brackets)	80 lb (36.3 kg)

For more information about the Cisco CRS 3-Phase AC PDU, refer to the Cisco CRS 3-Phase AC Power Distribution Unit Installation Guide.

Anchoring the Chassis to the Floor

The Cisco CRS chassis must be anchored (bolted) to the floor at the installation site. To assist with this task, an aluminum plate template (CRS-16-DRILLTEMP) can be ordered. The template provides drill positions for the chassis mounting-hole locations.

The template shows the chassis footprint and the pattern of holes that must be drilled into the floor for the mounting studs that secure the chassis to the floor (see Figure 10: Cisco CRS 16-Slot Line Card Chassis Enhanced Router Drill Template. The template includes several mounting-hole locations:

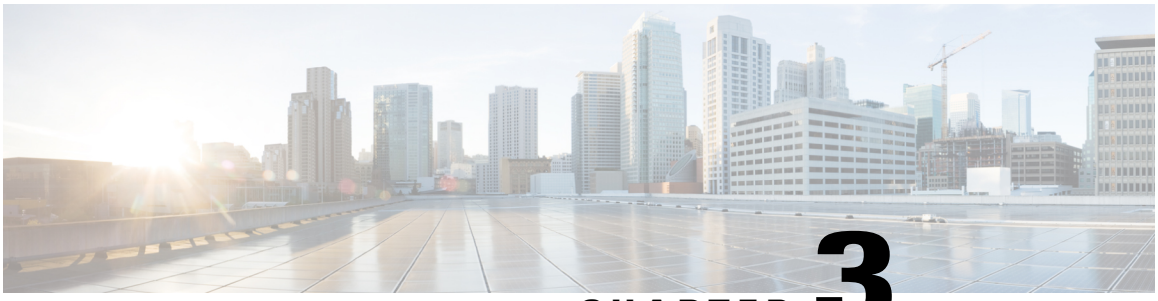
- Primary—Use these mounting-hole locations whenever possible.
- Secondary—Use these locations if it is not possible to use the primary locations.

Slab Concrete Floors

Cisco has contracted with Hilti Corporation to provide a kit for installation of the Cisco CRS chassis on concrete floors. The kit contains instructions, fasteners, and washers. In addition, a hammer drill is required to install the studs. For more information, see the Cisco CRS Carrier Routing System 16-Slot Line Card Chassis Enhanced Router Unpacking, Moving, and Securing Guide.

Raised Floors

If you plan to install the line card chassis on a raised floor, be sure to follow local practices.



CHAPTER 3

Power and Cooling Requirements

This chapter describes the power and cooling requirements for the Cisco CRS Series 16-Slot Line Card Chassis Enhanced. It contains the following sections:

Line Card Chassis Power System Overview

The chassis power system provides power to chassis components and is made up of two power shelves that contain power modules. Each power shelf is connected to a separate and independent power source. Input power enters the power shelves and is processed by the power modules before being distributed to the components in the chassis. At the shelf level, the power system provides 2N redundancy; the PMs themselves provide load-share redundancy. The power system also includes SNMP MIBS and XML support.

The line card chassis can be either DC or AC powered. The AC power system requires single-phase AC input power to the power shelves. If you have 3-phase AC Delta or AC Wye at your equipment, a Cisco CRS 3-Phase AC Power Distribution Unit*(PDU)* will be required to convert 3-phase AC input power to single-phase AC input power for the power shelf.

Note In an AC power system, PDU refers to the Cisco CRS 3-Phase AC Power Distribution Unit which is required to convert 3-phase AC-Wye or AC-Delta input power to single-phase AC input power for the AC power shelf. For further information and installation instructions, see http://www.cisco.com/en/US/docs/routers/crs/crs1/mux_box/installation/quick_start/guide/crs_pdu_qs.html Cisco CRS 3-Phase AC Power Distribution Unit Installation Guide.

Maximum input power requirements for the Cisco CRS 16-Slot Line Card Chassis Enhanced router are as follows:

- DC-powered chassis requires up to a maximum of 19,091 watts (19.09 kW) of DC input power when the chassis is fully loaded.
- AC-powered chassis requires up to a maximum of 19,565 watts (19.56 kW) of AC input power when the chassis is fully loaded.

Note If you have a Cisco CRS 3-Phase AC PDU installed, six AC PMs are required to be installed in each AC power shelf to maintain a balanced 3-phase power load.

Note These power requirements are for a fully loaded Cisco CRS 16-Slot Line Card Chassis Enhanced router with sixteen PLIMs. A chassis with fewer PLIMs uses slightly less power. However, it is a good idea to allocate this much power for each chassis to ensure that enough power is available for future system expansion.

See the Cisco CRS Carrier Routing System 16-Slot Line Card Chassis Enhanced Router System Description for detailed information about how each power system operates and distributes power to the components in the chassis.

General Power and Grounding Requirements

This section describes the power and grounding requirements you must consider when planning the site facilities for the line card chassis. In addition, see the DC Power System, on page 31 section or the AC Power System, on page 33 section for additional power requirements.

Note A certified electrician should review the information in these sections to ensure that the installation site meets these requirements. For larger system configurations, consult a facilities electrical expert to understand the load that the routing system may put on the facility power plant.

General power and grounding requirements are:

- Installation of the Cisco CRS 16-Slot Line Card Chassis Enhanced router must follow national and local electrical codes:
  - In the United States—United States National Fire Protection Association (NFPA) 70 and United States National Electrical Code (NEC)
  - In Canada—Canadian Electrical Code, part I, CSA C22.1
  - In other countries—International Electrotechnical Commission (IEC) 60364, parts 1 through 7
- Two separate and independent AC or DC power sources are needed to provide 2N redundancy for system power. Each power source requires its own circuit breaker.
- Site must provide short-circuit (over-current) protection for devices.
- Proper grounding is required at the site to ensure that equipment is not damaged by lightning and power surges. In addition:
  - Chassis grounding is required for AC and DC-powered systems.

- For AC-powered systems, a grounding-type AC power outlet is required.

- Site power planning must include the power requirements for any external terminals and test equipment you will use with your system.

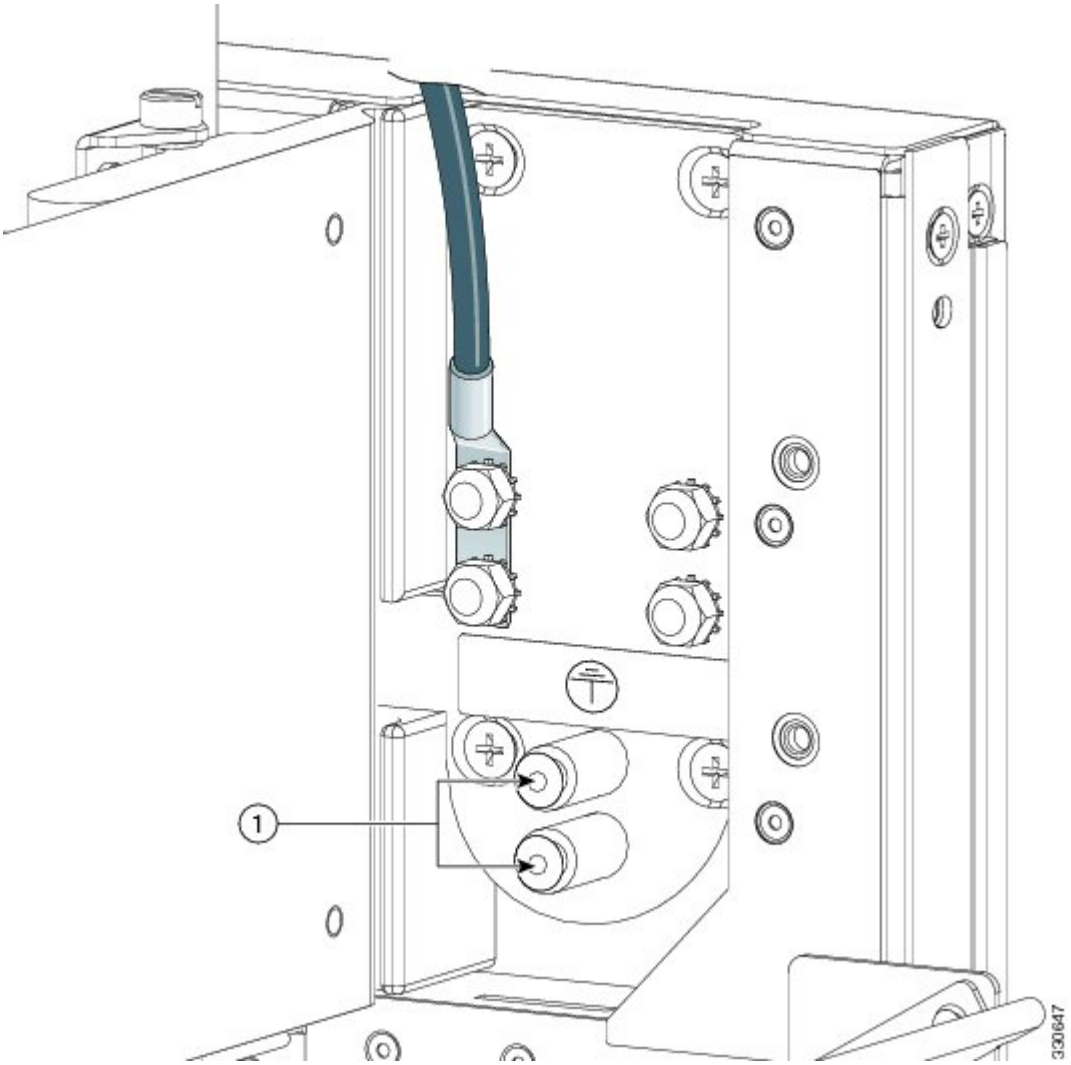
Note Be sure to review the safety warnings in Regulatory Compliance and Safety Information for the Cisco CRS Carrier Routing System before attempting to install the routing system.

Bonding and Grounding Guidelines

The router chassis has two safety earth ground connections. The chassis allows you to connect the central office ground system to the bonding and grounding receptacles on the router chassis. Threaded ground inserts are located on top of the chassis rear (MSC) side panel to the right of the lower power shelf. There are also two sets of grounding studs located at the bottom of the rear (MSC) side of the chassis. The following figure shows the NEBS and grounding points at the top on the rear (MSC) side of the chassis. This grounding point is also referred to as the network equipment building system (NEBS) bonding and grounding point.

Note These bonding and grounding receptacles are provided to satisfy the Telcordia NEBS requirements for bonding and grounding connections.

Figure 12: NEBS Bonding and Grounding Points—Top Rear (MSC) Side of Chassis

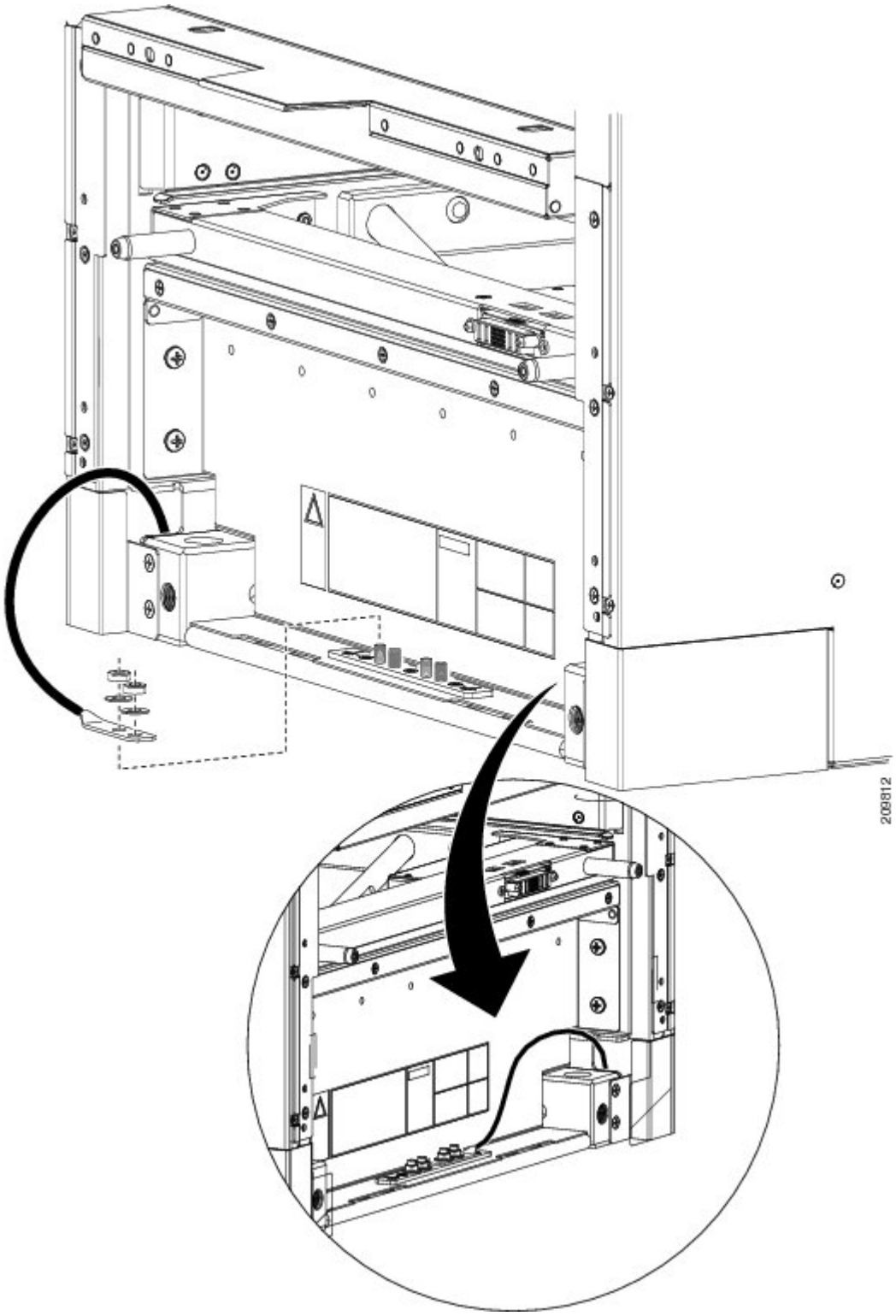


1	Two Torx security screws

Note The two bolts below the NEBS bonding and grounding points at the top of the chassis are required for proper bonding and grounding of the chassis and should not be removed.

The following figure shows the grounding points located at the bottom of the rear (MSC) side of the chassis.

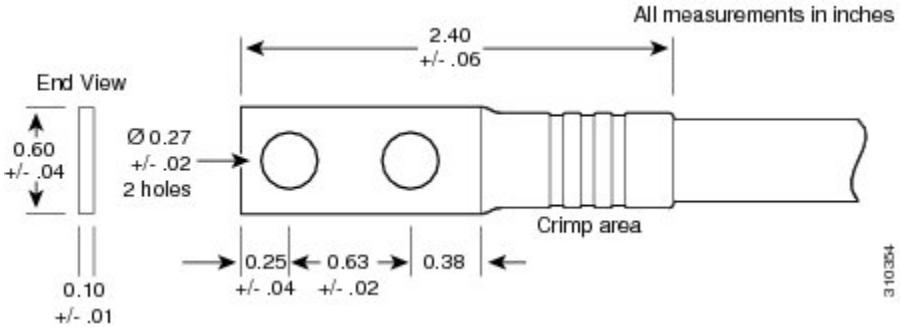
Figure 13: NEBS Bonding and Grounding Points - Bottom Rear of Chassis



To connect the chassis to a ground connection, you must have the following:

- One straight (180 degree) grounding lug that has two M6 bolt holes with 0.63 inch (5/8 inch) (1.60 cm) of spacing center to center between them and a 6-AWG or larger multistrand copper cable. See the following figure.

Figure 14: 180-Degree (Straight) Chassis Ground Lug



- Two M6 hex head bolts and integrated locking washers are pre-installed on the chassis.
- Cisco recommends at least 6 AWG multistrand copper cable. This cable is not available from Cisco Systems; it is available from any commercial cable vendor. The cable should be sized according to local and national installation requirements.

Note The DC return of this system should remain isolated from the system frame and chassis (DC-I: Isolated DC Return).

DC Power System

Each DC powered chassis contains two DC power shelves for 2N redundancy. The power shelves contain the input power connectors. Each shelf can contain up to eight DC PMs. The power shelves and DC PMs are field replaceable.

DC Power Requirements

Observe the following guidelines for DC-powered chassis. In addition, be sure to review the requirements in the General Power and Grounding Requirements, on page 26 section.

- Each DC-powered chassis requires up to a maximum of 19,091 watts (19.09 kW) of DC input power when the chassis is fully loaded.
- Two separate and independent power sources are required for N+N redundancy, each providing nominal –48/-60 VDC, 60 A service (eight inputs per shelf). The system will operate with power to only one shelf but will not have N+N redundancy.
- The power shelves are grounded internally.

- All power connection wiring should conform to the rules and regulations in the National Electrical Code (NEC) and any local codes. In addition, make sure that the wiring conforms to any internal requirements at the installation site
- Each DC power source must comply with the safety extra-low voltage (SELV) requirements in UL 60950-1, CSA-C22.2 No. 60950-1, EN60950-1, AS/NZS 60950, and IEC60950-1.
- A DC-powered system should be installed in a restricted access area in accordance with the National Electric Code, ANSI/NFPA 70.
- All components in the area where DC input power is accessible must be properly insulated.
- If it is not possible to rely on the identification of the earthed conductor in the DC mains supply, whereby the equipment is not provided with a two-pole disconnect device, then a two-pole disconnect device is to be provided external to the equipment.

The following table lists the DC input current and voltage specifications.

Table 3: DC Input Current and Voltage Information

Nominal input voltage	–48 VDC North America–60 VDC European Community(range: –40 VDC to –72 VDC)
Input line current	50 A maximum at –48 VDC40 A maximum at –60 VDC60 A maximum at -40 VDC

DC Power Shelf Wiring

Each DC power shelf contains eight pairs of double-stud terminals, covered by a plastic terminal block cover. To provide 2N power redundancy, one power shelf should be connected to the central office “A” power bus and the other power shelf should be connected to the “B” power bus.

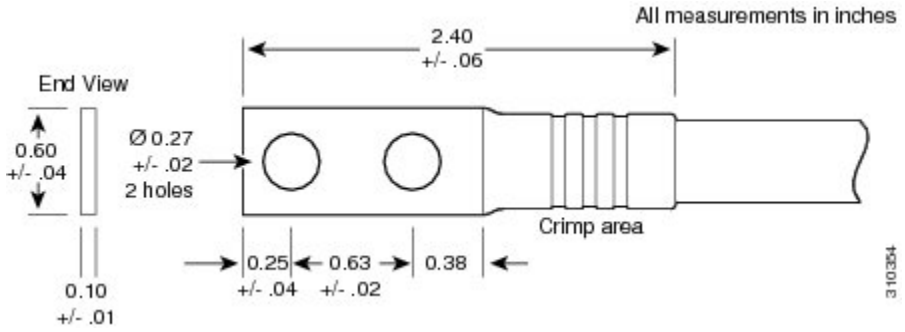
The requirements for the DC input power connections are as follows:

- Each power shelf requires up to eight pairs of distribution cables, DC (–48) and RTN (+).
- Paired battery and RTN cables should have the same cable lengths and should run together for equalization.
- Use the appropriate wire gauge for –48/-60 VDC, 60 A service. We recommend that you use a commensurately rated, high-strand-count copper cable. This cable is not available from Cisco Systems; it is available from any commercial vendor.

Caution A certified electrician must select the appropriate DC input power cable based on standard electrical practices, such as derating factors, wiring type, operating temperatures, and so on. The electrician must verify that the cable complies with the National Electrical Code (NEC) and local codes and any guidelines in effect at the installation site. At minimum, DC input power cables must be 6-AWG or heavier and rated for 90°C (194°F) temperature or higher.

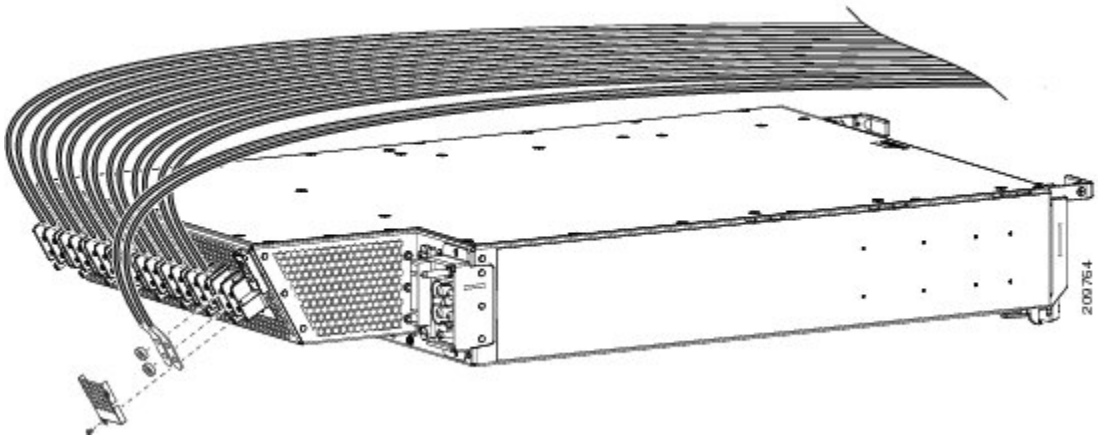
- Each DC input power cable is terminated at the power shelf by a cable lug. The cable lug must be dual hole and able to fit over M6 terminal studs at 0.63-inch (1.60 cm) centers. For example, you could terminate a 6-AWG power cable with a cable lug such as Panduit part number LCD2-14A-Q or equivalent. See the following figure.

Figure 15: DC Power Cable Lug



The following figure shows the DC input power cables connected to the DC power shelf terminal studs.

Figure 16: DC Power Shelf Cable Connections



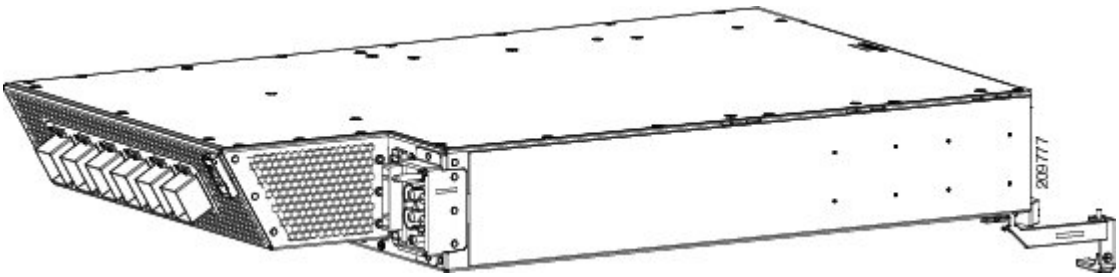
AC Power System

The chassis power system provides the necessary power for chassis components. Site power configurations may differ, depending on the input source available, i.e. single-phase AC, AC Delta or AC Wye.

Each AC powered chassis contains two AC power shelves for 2N redundancy. The power shelves contain the input power connectors. Each shelf can contain up to six AC PMs. The power shelves and AC PMs are field replaceable.

The following figure shows the rear side of the AC power shelf.

Figure 17: Rear of AC Power Shelf



AC Power Requirements

In addition to the requirements in the General Power and Grounding Requirements, on page 26 section, AC input power requirements are as follows:

- An AC-powered chassis requires up to a maximum of 19,565 watts (19.56 kW) of AC input power when the chassis is fully loaded.
- Two separate and independent AC power sources are required for N+N redundancy, one for each power shelf. Each power shelf should be connected to a different power source to provide 2N power redundancy in case a power source fails. The system will operate with power to only one shelf but will not have N+N redundancy.
- Each AC power source must provide single-phase AC power, and have its own circuit breaker.
- The AC power receptacles used to plug in the chassis must be the grounding type. The grounding conductors that connect to the receptacles should connect to protective earth ground at the service equipment.
- AC single-phase input:
  - Single-phase, 200 to 240 VAC nominal, 50 to 60 Hz, 16 A International and 20 A North America.
  - Each AC power shelf contains six IEC-320-C22 receptacles which can accept up to six IEC-320-C21 connector female plugs.
- If it is not possible to rely on the identification of the earthed conductor in the AC mains supply, whereby the equipment is not provided with a two-pole disconnect device, then a two-pole disconnect device is to be provided external to the equipment.
- If you have 3-phase AC Delta or AC Wye at your equipment, a Cisco CRS 3-Phase AC PDU will be required to convert 3-phase AC input power to single-phase AC input power for the power shelf. For further information, refer to Cisco CRS 3-Phase AC Power Distribution Unit Installation Guide.

Note If you have a Cisco CRS 3-Phase AC PDU installed, six AC PMs are required to be installed in each AC power shelf to maintain a balanced 3-phase power load.

For detailed AC power specifications, see the Line Card Chassis Specifications, on page 77 section.

AC Power Shelf Wiring

The AC power shelf is shipped with AC power cords. Each AC power shelf accepts up to six power cords. Each power cord is 4.25 m in length and different plug types (pre-attached) are available, depending on the locale. AC cords are available for the following locales:

- North America
- Europe
- United Kingdom
- Italy
- Australia

The following table lists the single-phase AC-input cord power options and Cisco product numbers for the Cisco CRS 16-Slot Line Card Chassis Enhanced router with an AC power shelf installed. The table also references power cord illustrations.

Table 4: AC-Input Power Cord Options

Locale	Cisco Product Number	Plug Rating	Reference Illustration
North America	CRS-AC-CAB-NA(=)	20 A/250 VAC	Figure 18: North America—AC-Input Power Cord
Europe	CRS-AC-CAB-EU(=)	16 A/250 VAC	Figure 19: Europe—AC-Input Power Cord
United Kingdom	CRS-AC-CAB-UK(=)	13 A/250 VAC	Figure 20: United Kingdom—AC-Input Power Cord
Italy	CRS-AC-CAB-IT(=)	16 A/250 VAC	Figure 21: Italy—AC-Input Power Cord
Australia	CRS-AC-CAB-AU(=)	15 A/250 VAC	Figure 22: Australia—AC-Input Power Cord

Figure 18: North America—AC-Input Power Cord

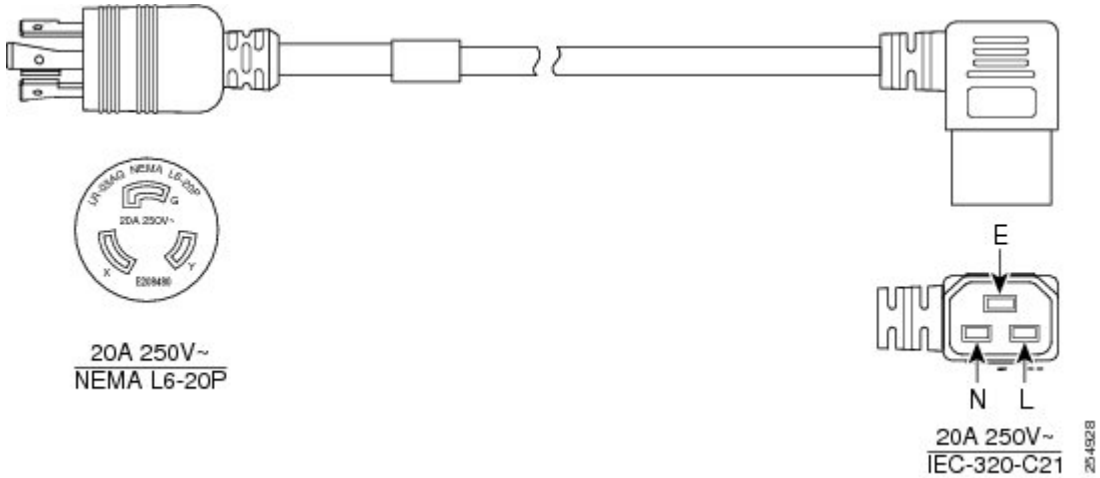


Figure 19: Europe—AC-Input Power Cord

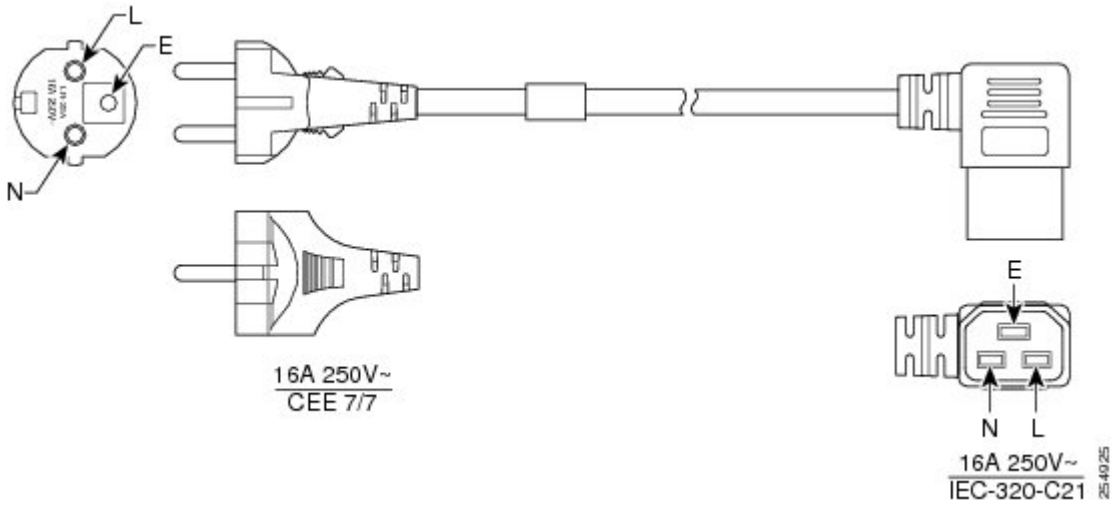
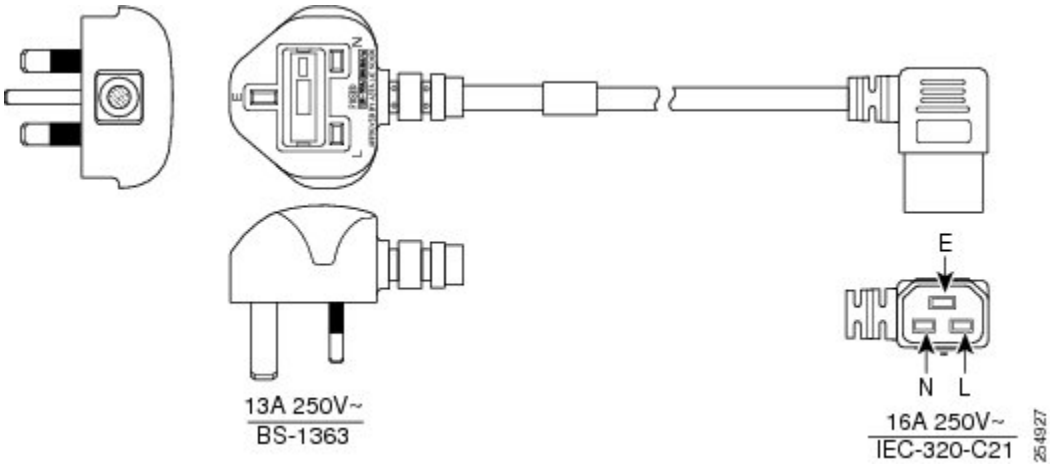


Figure 20: United Kingdom—AC-Input Power Cord


E
N
L
13A 250V~
BS-1363
16A 250V~
IEC-320-C21
254927

Note The BS-1363 standard rates cord sets up to a maximum of 13 A, 250 VAC for the C-21 plug. Therefore, the building circuit breaker must be 13 A maximum. Installation of the Cisco CRS 16-Slot Line Card Chassis Enhanced router must follow national and local electrical codes.

Figure 21: Italy—AC-Input Power Cord

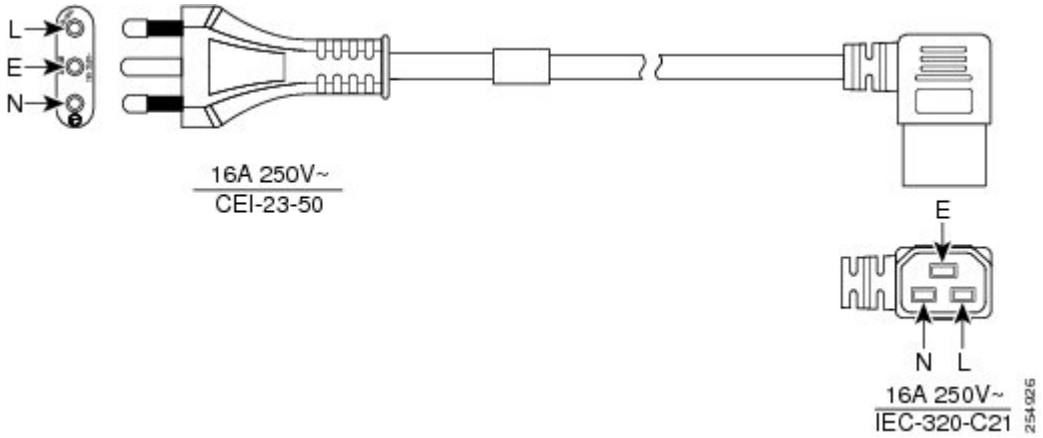
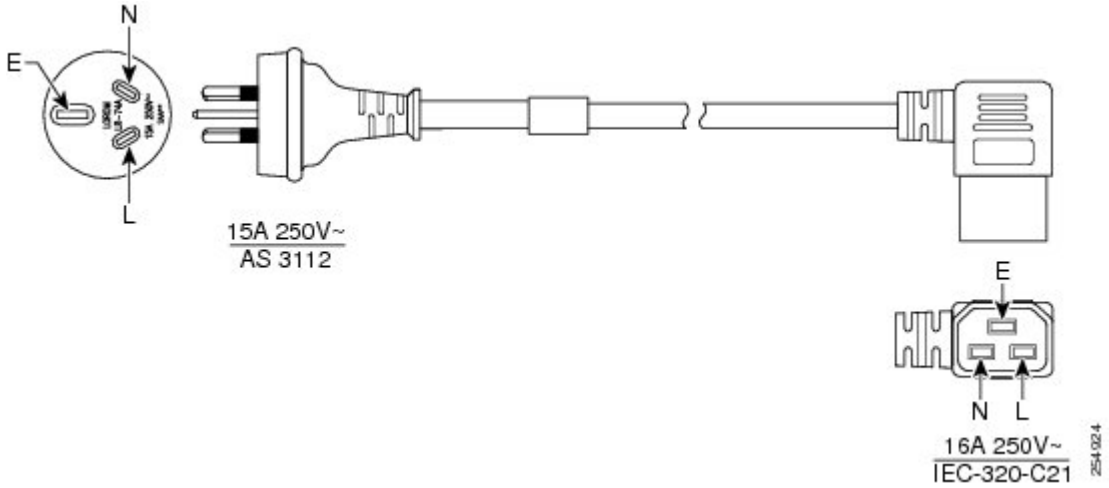


Figure 22: Australia—AC-Input Power Cord



Note The AS 3112 standard rates cord sets up to a maximum of 15 A, 250 VAC for the C-21 plug. Therefore the building circuit breaker must be 15 A maximum. Installation of the Cisco CRS 16-Slot Line Card Chassis Enhanced router must follow national and local electrical codes.

Converting 3-Phase AC to Single-Phase AC

If you have 3-phase AC Delta or AC Wye input power at your equipment, a Cisco CRS 3-Phase AC PDU will be required to convert 3-phase AC Delta or AC Wye input power to single-phase AC input power that connects directly to the rear of the AC power shelf. The Cisco CRS 3-Phase AC PDU includes either an AC Delta or AC Wye power interface, and has power input and power output cords entering and exiting the box.

There are two versions of the Cisco CRS 3-Phase AC PDU for the Cisco CRS 16-Slot Line Card Chassis Enhanced router available:

- CRS-16-PDU-Delta—Redundant 3-phase to single-phase Delta PDU for the Cisco CRS 16-Slot Line Card Chassis Enhanced router, 4 input/12 output
- CRS-16-PDU-Wye—Redundant 3-phase to single-phase Wye PDU for the Cisco CRS 16-Slot Line Card Chassis Enhanced router, 2 input/12 output

In addition to the requirements in the General Power and Grounding Requirements, on page 26 section, AC input power requirements are as follows:

- Two separate and independent AC power sources are required, one for each PDU. Each PDU should be connected to a different power source to provide 2N power redundancy in case a power source fails. The system will operate with power to only one shelf but will not have N+N redundancy.
- Each AC power source must provide 3-phase VAC power, and have its own circuit breaker.
- AC Delta input:
  - 3-phase, 200 to 240 VAC (phase-to-phase), 50 to 60 Hz.
  - Input current: 2 x 27.7A.
  - Each PDU has two Delta input power cords preattached, each with a 4-pin IEC 60309 plug (3 wire + protective earthing [3W+PE]). The power cord is rated for 250 VAC, 60 A, and plugs into a similarly rated IEC 60309 receptacle.
  - Each PDU has six single phase output cords preattached, each with a 90 degree IEC-320-C21 plug that plugs into a IEC-320-C22 inlet on the rear of the AC power shelf.
- AC Wye input:
  - 3-phase, 200 to 240/346 to 415 VAC (phase-to-neutral), 50 to 60 Hz.
  - Input current: 32 A.
  - Each PDU has one Wye input power cord preattached, with a 5-pin IEC 60309 plug (3 wire + neutral + protective earthing conductor (ground wire) [3W+N+PE]). The cord is rated for 415 VAC, 16 A, and plugs into a similarly rated IEC 60309 receptacle.
  - Each single PDU has six single phase output cords preattached, each with a 90 degree IEC-320-C21 plug that plugs into a IEC-320-C22 inlet on the rear of the AC power shelf.

- Grounding-type AC power outlet is required. The PDUs are shipped with AC power cords that have a grounding-type plug. As a safety feature, the plugs fit only a grounding-type AC power outlet.

Figure 23: AC Delta Power Cord Plug

Figure 24: AC Wye Power Cord Plug

For detailed Cisco CRS 3-Phase AC PDU AC power specifications, see the Cisco CRS 3-Phase AC Power Distribution Unit Installation Guide.

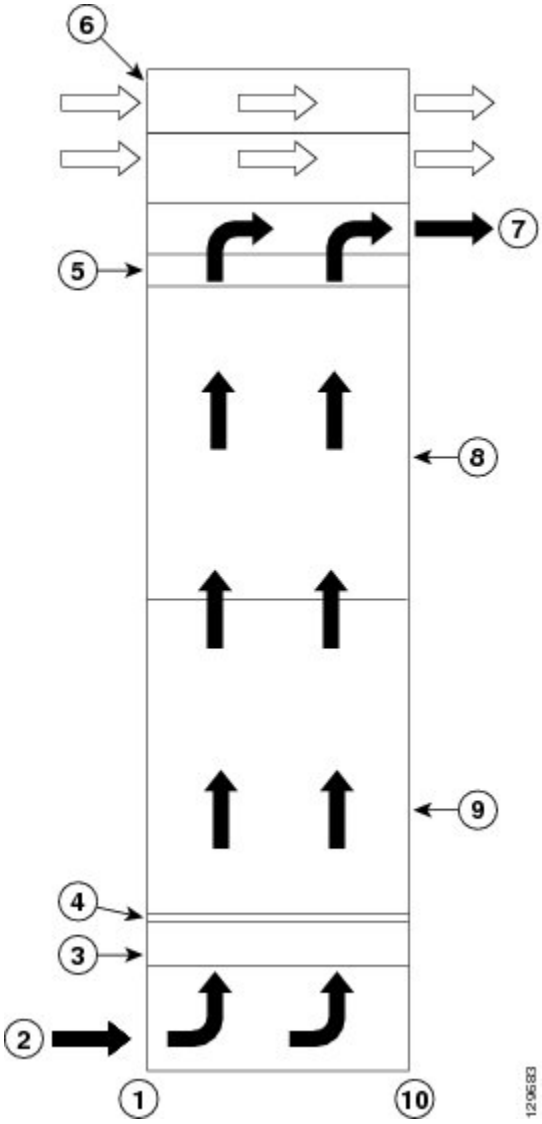
Cisco CRS 16-Slot Line Card Chassis Enhanced Router Airflow

The airflow through the Cisco CRS 16-Slot Line Card Chassis Enhanced router is controlled by a push-pull configuration. As shown in the following figure, ambient air flows in at the bottom front of the Cisco CRS 16-Slot Line Card Chassis Enhanced router and up through the card cages until it exhausts at the top rear. The bottom fan tray pulls ambient air in from the bottom front of the chassis; the top fan tray pushes warm air out the back of the chassis. The power modules in the power shelves have their own self-contained cooling fans.

A replaceable air filter is positioned above the lower fan tray. How often the air filter should be replaced depends on the facility environment. In a dirty environment, or when you start getting frequent temperature alarms, you should always check the intake grills for debris and the air filter to see if it needs replacement.

Before removing the air filter for replacement, you should have a spare filter on hand; follow the air filter replacement procedure in the Cisco CRS Carrier Routing System 16-Slot Line Card Chassis Enhanced Installation Guide

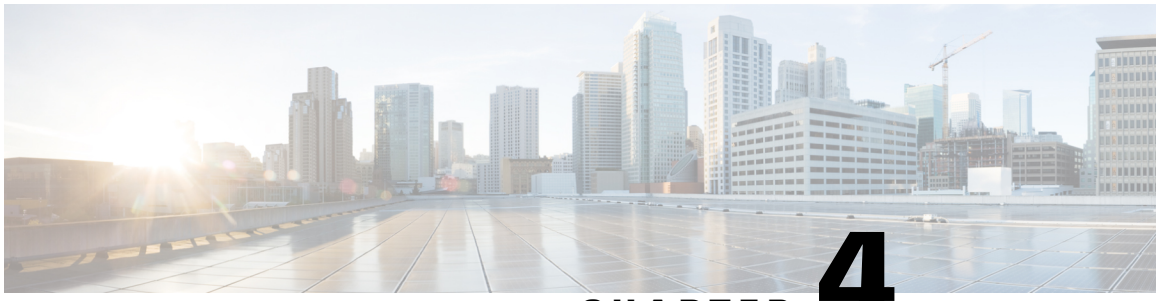
Figure 25: Airflow Through Line Card Chassis



1	Front (PLIM) side of chassis	6	Power shelves (two installed)
2	Air intake	7	Air exhaust
3	Lower fan tray	8	Upper card cage
4	Air filter	9	Lower card cage

5	Upper fan tray	10	Rear (MSC) side of chassis

The Cisco CRS 16-Slot Line Card Chassis Enhanced router has a maximum airflow of 2,700 cubic feet (76,455 liters) per minute.



CHAPTER 4

Shipping and Receiving

This chapter describes the issues to consider as you prepare to receive shipment of the Cisco CRS Series 16-Slot Line Card Chassis Enhanced and transport the chassis components to the installation site.

It includes the following sections:

Receiving and Storing Routing System Components

When planning your Cisco CRS 16-Slot Line Card Chassis Enhanced router installation, you must consider how the routing system components will be moved from the shipping dock to the site where the chassis is to be installed. This section, and the sections that follow, provide information about the things to consider as you plan on how to transport the system components from the loading dock to the installation site.

The line card chassis is shipped in several crates that reduce the potential for product damage during routine material handling and shipment. To protect the chassis:

- Always store the chassis in its original packaging in an upright position.
- If you plan to store chassis components before the installation, be sure to store the components carefully and in their original shipping containers to prevent accidental damage.

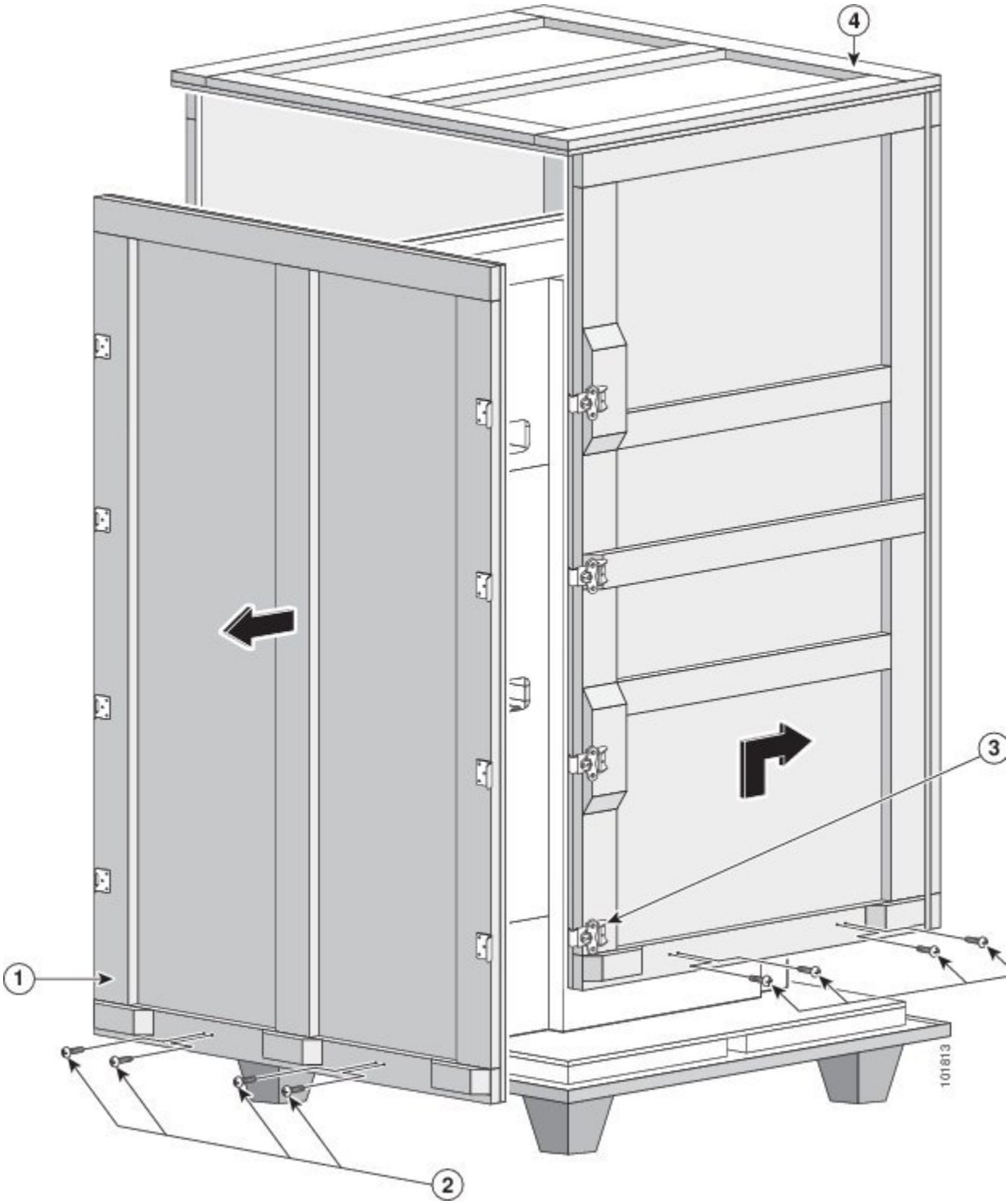
Note When you are planning the transportation route and storage area, consider the shipping pallet and crate dimensions. (See Table 1.)

Shipping Crates and Pallets

Depending on the number of options you ordered, the Cisco CRS Series 16-Slot Line Card Chassis Enhanced arrives packaged in several shipping crates and pallets. The line card chassis is shipped on a pallet by itself and arrives inside a polyethylene bag enclosed in a plywood box, held in place by steel clips (see the following

figure). Other system components are shipped in separate crates. For complete details on the contents of each crate, see the shipping and parts identification label on the crate.

Figure 26: Cisco CRS 16-Slot Line Card Chassis Enhanced in Original Packaging



1	Lock latches	3	Four-sided plywood box
2	Large side panel		

Caution Do not stack the Cisco CRS shipping crates, because serious damage to the system components can occur.

The following table lists the physical characteristics of the chassis shipping crate.

Table 5: Line Card Chassis Shipping Crate and Pallet Weight and Dimensions

Weight (Est. max.)	**1300 lb (589 kg)—Chassis in shipping crate with pallet**
Dimensions	Height: 92 in. (233.7 cm)
	Width: 45 in. (114.3 cm)
	Length: 48 in. (121.9 cm)

Unpacking and Storage of Chassis and Chassis Components

Consider the following as you plan for the unpacking and storage of chassis components:

- Make sure that enough room exists at the loading dock or installation site to unpack the system components. If you plan to store the components before installation, make sure that you have an area large enough in which to store the system components. Note that you should store components in their shipping crates until you are ready to install them.
- You should unpack the chassis and chassis components in the following order:
  - Chassis
  - Power System
  - Exterior cosmetics
  - MSCs and PLIMs
- Will you unpack the chassis components from their shipping crates at the loading dock or installation site? Consider the following:
  - Are corridors and aisles from the loading dock to the installation site wide enough for the moving device and the chassis and components in their crates or pallets?
  - To use the dolly supplied by Cisco to transport the chassis to the installation site, you must unpack the chassis to attach the dolly.
  - If aisles are not wide enough, you might want to unpack components at the loading dock. Of course, you must make sure that there is enough room.
  - Is there enough room at the installation site to unpack chassis components? If not, can system components be unpacked at the loading dock?

- Consider how you will move the chassis components from the shipping dock to the installation site. See the next section.

Transport to the Installation Site

This section describes the things to consider as you plan the route to use to move the chassis from the loading dock to the installation site. See Table 2 for the minimum hallway, aisle, and doorway clearances required to accommodate the chassis.

Before you attempt to move the chassis to the installation site, we recommend that you check the proposed transport route and note any areas of concern. It might also be useful to create a diagram of the route you plan to take from the loading dock to the installation site.

Note We recommend that at least two people move the chassis from the shipping dock to the installation site.

- Is the installation site on a different floor than the loading dock? If so, are there freight elevators that can be used to transport the system components?
  - Can freight elevators support the weight of the system chassis and the moving device?
  - Are elevators tall and wide enough for system components (with or without shipping crates)?
- Are there any ramps in the transport route? If so, the following guidelines apply:
  - We recommend maximum of 1 inch of rise for every 12 inches of run.
  - Maximum limit of 1 inch of rise for every 6 inches of run. If the ramp exceeds the maximum limit, consult with Cisco Technical Staff.
- Are there any raised floors in the transport route or at the installation site that need to be protected while you move the chassis?
- Make sure that hallways, aisles, and doorways are high and wide enough to accommodate the chassis and moving device.
- Make sure that corners are wide enough for the chassis and moving device.
- Make sure that no obstacles exist in the transport route (for example, boxes or equipment in hallways, hanging wires, or items on the floor).
- Ensure that the dolly supplied by Cisco is available to transport the uncrated chassis from the shipping dock to the chassis final location. The chassis is shipped with blanks and impedance carriers pre-installed. If more need to be ordered, go to the Cisco online ordering and pricing tool at: http://www.cisco.com

Important Notice About Transporting the Chassis

Either a fork lift or pallet jack can be used to transport a crated chassis only.

Throughout this chapter we refer to the dolly (supplied by Cisco) as the required means to transport the uncrated chassis from the shipping dock to the chassis final location.

Note In the event that the dolly supplied by Cisco is not the appropriate method of transportation, consult Cisco Technical Staff to determine a method of transportation appropriate for the site. Ensure that the alternate lifting device is capable of moving the chassis safely, supporting the weight of the chassis, and is capable of preventing the chassis from tipping.

Caution When using any type of device to transport the chassis, exercise extreme caution and follow proper safety practices.

Using the dolly supplied by Cisco to Move the Chassis—Things to Consider

If you plan to use the dolly supplied by Cisco to move the chassis, consider the following:

- Dolly is optimized to move the chassis on flat surfaces. It is not designed to move the chassis up stairs, over curbs, up ramps greater than 1 inch of rise for every 6 inches of run, or over bumps more than 1.5 inch (3.8 cm) high, such as door thresholds.
- Before attaching the dolly, ensure that the power shelves, power modules, MSCs and PLIMs have been removed from the chassis. Ensure that impedance carriers have been installed to prevent dust and debris from entering the card cage during movement and installation.
- Whenever possible, use the dolly in the 180-degree configuration to move the chassis. Hallways and aisles must be at least 52 inches (132 cm) wide to accommodate the combined dolly and chassis width. The dolly in its 90-degree configuration requires 32 inches (81 cm) of hallway and aisle clearance, but requires extra care to avoid tipping the chassis.

For instructions on assembling and using the dolly supplied by Cisco, see the Cisco CRS Carrier Routing System 16-Slot Line Card Chassis Enhanced Router Unpacking, Moving, and Securing Guide.

Verifying the Move Path

Before moving the chassis, it is critical that you verify that the path that you are planning to use to move the chassis to its final location can accommodate the chassis size and weight and the restrictions of the chassis when using the dolly (see the Planning for Future Expansion, on page 23 section).

See the following table for a list of the restrictions for your move path, and verify that you have sufficient room for the *entire* move path before moving the chassis.

Table 6: Chassis Move Path Specifications

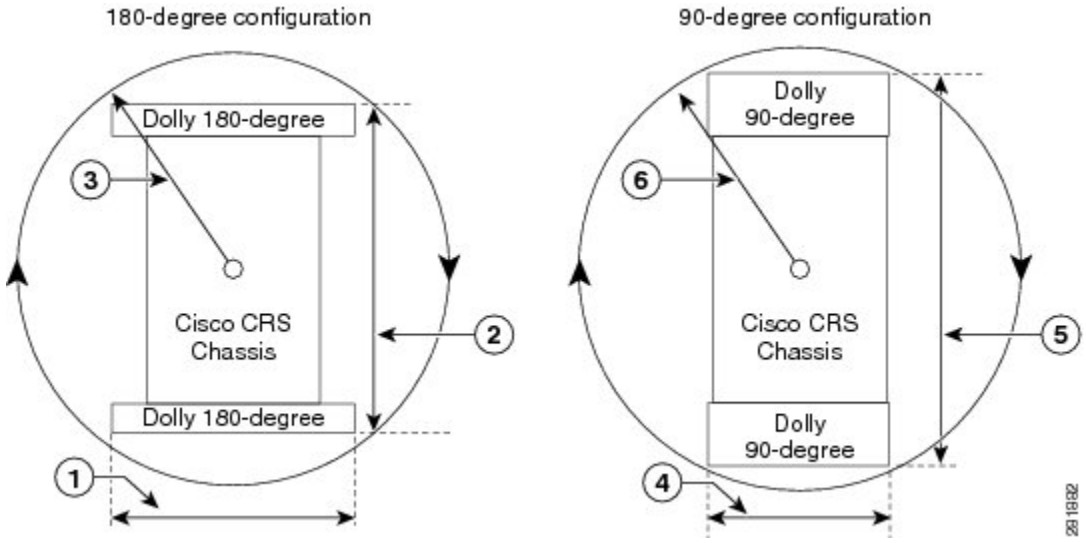
Specification	Value
Height (on dolly, with recommended 1 inch raise)	85 in. (215.9 cm)
Depth (on dolly, 90-degree dolly position)	70 in. (177 cm)
Depth (on dolly, 180-degree dolly position)	48 in. (121 cm)
Width (on dolly, 90-degree dolly position)	23.6 in. (60 cm)

Specification	Value
Width (on dolly, 180-degree dolly position)	44 in. (112 cm)
Turning radius (on dolly, 90-degree dolly position)	37 in. (94 cm)
Turning radius (on dolly, 180-degree dolly position)	33 in. (83 cm)
Weight of chassis (as shipped, configuration, packaging removed)	993 lb (450 kg) (Estimated)
Weight of dolly	126 lb (57.3 kg)
Maximum recommended height from floor height (chassis on dolly)	1.5 in. (3.8 cm)

Note Allow a minimum gap of between 4 to 6 in. (10 to 15 cm) on each side of the combined chassis and dolly when moving it.

The following figure shows the recommended minimum space to turn the chassis on the dolly in its 90-degree and 180-degree configuration.

Figure 27: Recommended Turning Diameter of Dolly



1	Width (on dolly, 180-degree position) 44 in. (112 cm)	4	Width (on dolly, 90-degree position) 24 in. (60 cm)

2	Depth (on dolly, 180-degree position) 48 in. (122 cm)	5	Depth (on dolly, 90-degree position) 70 in. (178 cm)
3	Turn radius (on dolly, 180-degree position) 33 in. (83 cm)	6	Turn radius (on dolly, 90-degree position) 37 in. (94cm)

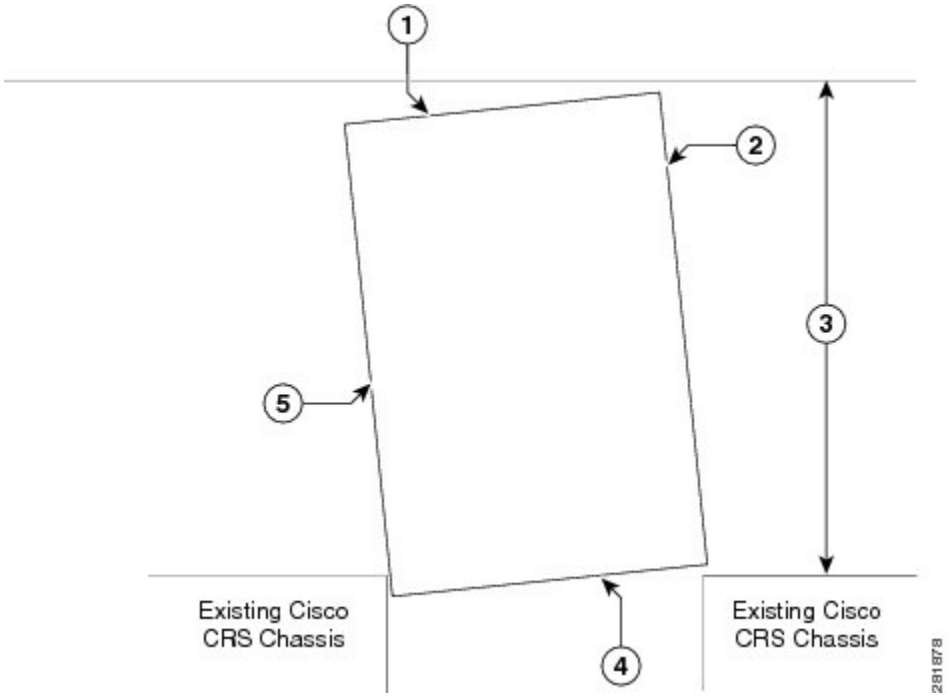
The following table provides the dolly width and the recommended aisle width turning radius for the 90-degree and 180-degree dolly configuration.

Table 7: Chassis Turning Recommendations

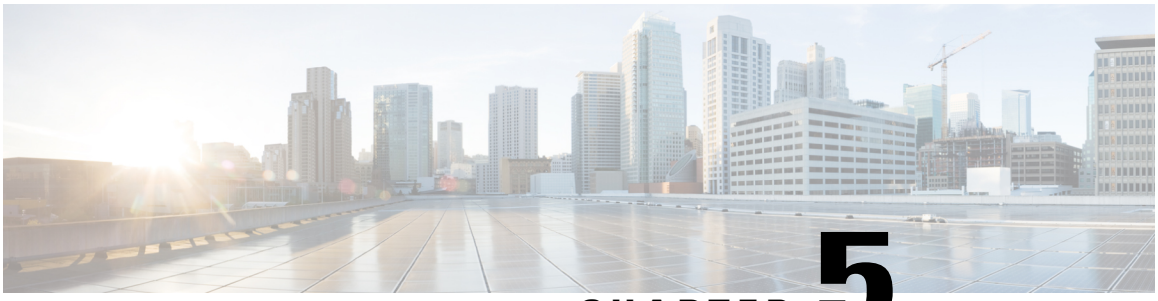
Dolly Configuration	Width of Combined Chassis and Dolly	Recommended Aisle Width Turning Radius
90-degree dolly position	24 in. (60 cm)	37 in. (94cm) **Note** Aisle width may be different when transporting the chassis around a corner.
180-degree dolly position	44 in. (112 cm)	33 in. (83 cm)

The following figure is a top view of the minimum aisle space required to install the Cisco CRS 16-Slot Line Card Chassis Enhanced router without using the dolly supplied by Cisco.

Figure 28: Minimum Aisle Space Requirements to Install Chassis—Top View (With Dolly Removed)



1	Chassis front	4	Chassis rear
2	Chassis side	5	Chassis side
3	Moving space requirement: 34.7 in. (95 cm)		



CHAPTER 5

System Planning Considerations

This chapter describes the system planning considerations for your Cisco CRS Series 16-Slot Line Card Chassis Enhanced installation. It includes the following sections:

Planning for High Availability

Following is a list of tasks to configure the line card chassis for high availability, which helps to ensure that service is not disrupted due to failures:

- Install a redundant Cisco CRS 16-Slot Line Card Chassis Enhanced router, whose user interface links mirror the links on the other Cisco CRS 16-Slot Line Card Chassis Enhanced router. This way, if something happens to one Cisco CRS 16-Slot Line Card Chassis Enhanced router, the links are still operational on the other Cisco CRS 16-Slot Line Card Chassis Enhanced router. To provide more high availability, install each Cisco CRS 16-Slot Line Card Chassis Enhanced router in a different room, located in a different fire and power zone. This way, a problem in one room should not affect the operation of the other chassis.
- Run the power cables from each of the two power sources along different routes through the facility or at the installation site.
- Run PLIM user interface cables along different routes.

Using DRPs and DRP PLIMs to Increase Routing Performance

The Cisco CRS distributed route processor (DRP) and its companion card (DRP PLIM) are optional components that can be installed in the line card chassis to provide enhanced routing capabilities for Cisco CRS routers. The DRP is installed in any MSC slot. The DRP PLIM is installed in the corresponding PLIM slot.

- The DRP contains two symmetric multiprocessors (SMPs), each of which performs routing functions. Processor-intensive tasks (such as BGP speakers and ISIS) can be offloaded from the route processors (RPs) to the DRPs to improve the routing performance of the Cisco CRS router.
- The DRP PLIM contains RJ-45 ports to connect the DRP to the system management console for configuration and management. The DRP has no ports.

Power

Before installing a Cisco CRS Series 16-Slot Line Card Chassis Enhanced, you must carefully plan the facility power required to support it. The power requirements are based on the number of line card chassis that you plan to install. When planning the power layout for a routing system, you should also include the power requirements of peripheral equipment (such as the external terminals), the network management equipment, and the test equipment you will use with your system.

For larger system configurations, it may be advisable to consult with a facilities electrical expert to understand the load that a routing system may put on the power plant of your facility. Always follow local electrical codes.

Note Power and Cooling Requirements, on page 25 provides detailed power and cooling requirements.

Cable Management

As the size of the routing system increases, the cabling required for the chassis increases. For example, a fully loaded chassis has more cables connected to it than a partially loaded chassis.

The cabling runs must be carefully planned. The basic configurations for various routing systems should be arranged to minimize the complexity and length of the cable runs. Terminated cables are considered part of the basic configuration.

Physical Layer Interface Module Cables

You must provide the line card- PLIM interface cables and the cable management trays for these cables from the Cisco CRS 16-Slot Line Card Chassis Enhanced router to your facility interconnect.

Because the type and number of MSCs, FPs, and PLIMs vary with each routing system site, plan these data cable runs in advance of the system installation.

When planning the data cable runs, consider the:

- Number and type of interface connections to PLIMs and SPAs

- Termination at the other end of the cables (patch panel, optical transport equipment, and so on)
- Proper length and termination of cables

Noise Control

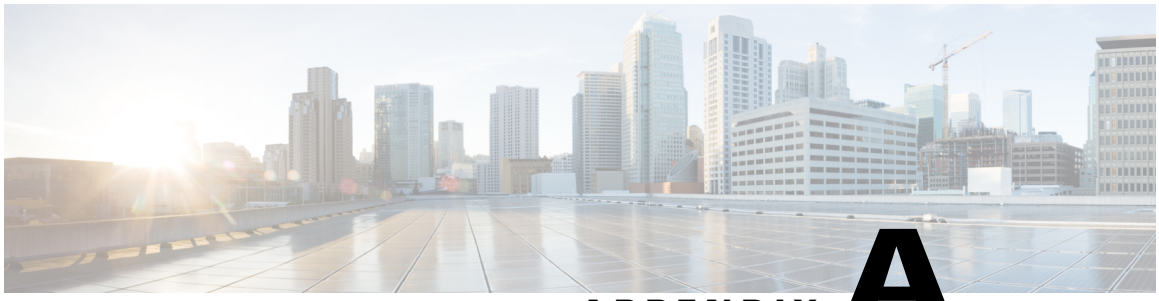
The line card chassis has built-in noise reduction, such as fan speed control.

Cisco Installation Services

Cisco or a Cisco partner can provide a total installation, from planning to test and turn-up. For information about Cisco (or Cisco partner) installation services, contact Cisco Customer Advocacy.

System Testing, Certification, and Warranty

After a Cisco CRS Series 16-Slot Line Card Chassis Enhanced router has been installed, it has to be tested and certified. Contact Cisco Customer Advocacy for information about testing, certification, and warranties.



APPENDIX A

Product IDs

This appendix provides information about the product structure, product IDs, and hardware compatibility. It contains:

The table lists system components, their product IDs (the part numbers to use to order the component), and descriptions.

Note In the following tables, an equals sign (=) at the end of the product ID indicates that the component can be ordered as a spare. For those components, be sure to include the equals sign as part of the product ID.

Note Although this appendix provides product IDs for routing system components, the Cisco online ordering and pricing tool has the most up-to-date information on the routing system and product IDs: http://www.cisco.com. CCO login is required. Enter a search term such as "CRS" to view a list of components.

Cisco CRS 16-Slot Line Card Chassis Enhanced Router Product IDs

The following table lists the PIDs for the Cisco CRS 16-Slot Line Card Chassis Enhanced router and its components.

Table 8: Cisco CRS 16-Slot Line Card Chassis Enhanced Router Product IDs

Component	Product ID	Description
Line card chassis	[illegible]	Cisco CRS 16-Slot Line Card Chassis Enhanced router for CRS-3 CRS 16 slot Carrier Routing System Enhanced CRS 16 slot line card chassis-V3
Switch fabric cards		

Component	Product ID	Description
Switch fabric card (eight per system)	[illegible]	S123 switch fabric cards for CRS-1 40G system S123 switch fabric cards for CRS-3 140G system S123 switch fabric cards for CRS-X 400G system (8 required for each Cisco CRS 16-Slot Line Card Chassis Enhanced router)

Component	Product ID	Description
Switch fabric card (multiple required for system)	[illegible]	S13 switch fabric cards for CRS-1 140G system S13 switch fabric cards for CRS-3 140G system S13 switch fabric cards for CRS-X 400G system (8 required for each Cisco CRS 16-Slot Line Card Chassis Enhanced router)
Route processors		

Component	Product ID	Description
Route processor	CRS-RP= (spare)	Route processor (2 required for each Cisco CRS 16-Slot Line Card Chassis Enhanced router)
Performance route processor (PRP)	CRS-PRP-6= (spare) CRS-PRP-12= (spare)	Performance route processor (6GB memory) Performance route processor (12GB memory) (2 PRPs required for each Cisco CRS 16-Slot Line Card Chassis Enhanced router)

Component	Product ID	Description
Distributed route processor (DRP)	CRS-DRP/2	Additional route processor for the system (optional) (includes two cards, DRP CPU and DRP PLIM)
	To order DRP cards separately, use the following IDs (both cards are required for DRP operation)	
	[illegible]	DRP card only (requires DRP PLIM)
	[illegible]	DRP PLIM only (requires DRP CPU)
Power		

Component	Product ID	Description
AC power system	[illegible]	CRS modular power AC kit for CRS AC power shelf for CRS CRS 16 slot AC power shelf for CRS
DC power system	[illegible]	CRS modular power DC kit for CRS DC power shelf for CRS CRS 16 slot DC power shelf for CRS

Component	Product ID	Description
AC power module	[illegible]	AC power module (Up to 6 required for each power shelf)
DC power module	[illegible]	DC power module (Up to 8 required for each power shelf)
Alarm module	[illegible]	CRS 16 slot alarm board for CRS-3

Component	Product ID	Description	
AC power cord	CAB-AC-2500W-US1 CAB-AC-2500W-US2 CAB-AC-2500W-EA CAB-AC-2500W-INT CAB-AC-2500W-ISR	AC power cord—North America AC power cord—Australia AC power cord—United Kingdom AC power cord—Europe AC power cord—Italy **Note** Length of each power cord is 4.25 m.	
Power Distribution Unit (PDU)	CAB-3PHASE-DELTA CAB-3PHASE-WYE	3-phase to single-phase AC Delta PDU for line card chassis 3-phase to single-phase AC Wye PDU for line card chassis	

Component	Product ID	Description
Cooling		
Fan tray	[illegible]	CRS 16 slot fan tray for CRS-[illegible]
Fan controller	[illegible]	CRS fan controller for CRS-[illegible]
Cable management and cosmetics		
Front cable management	[illegible]	CRS 16 slot front cable management for CRS-[illegible]
Rear cable management	[illegible]	CRS 16 slot chassis rear cable management for CRS-[illegible]
Front door	[illegible]	CRS 16 slot chassis front doors for CRS-[illegible]

Component	Product ID	Description
Rear door	[illegible]	CRS 16 slot chassis rear doors for CRS-X
Power grille	[illegible]	CRS modular power grille for CRS-X
Chassis installation accessories (included with chassis)		
Drill hole template	[illegible]	CRS 16 slot drill template for CRS-X
Chassis access template	[illegible]	CRS 16 slot floor template for CRS-X
For detailed specifications for Cisco CRS PLIMs, RPs and other components refer to the data sheet on: http://www.cisco.com/en/US/partner/products/ps5763/products_data_sheets_list.html. CCO login is required.		
For additional information on Cisco CRS SPA interface processor (SIP) and shared port adapters (SPAs), see *Cisco CRS SIP and SPA Hardware Installation Guide*.		

Cisco CRS 16-Slot Line Card Chassis Enhanced Router Component Hardware Compatibility

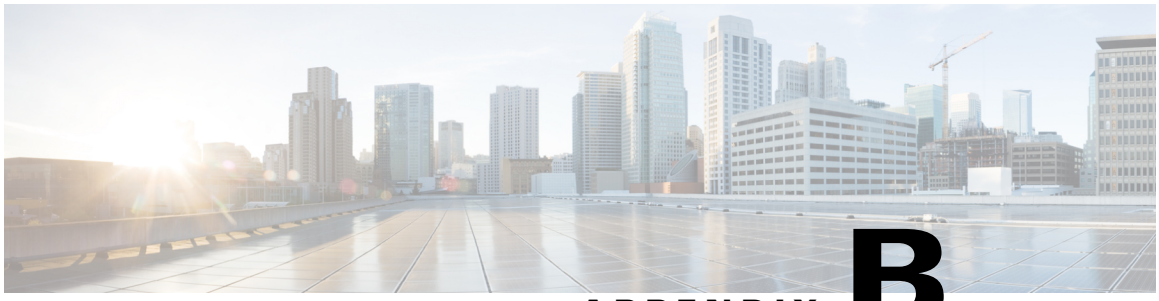
The following table lists the compatibility of 40G CRS and 140G CRS fabric, forwarding, and line card components for the Cisco CRS 16-Slot Line Card Chassis Enhanced router.

Note A router with a mix of 40G and 140G fabric cards is not a supported mode of operation. Such a mode is temporarily allowed only during the upgrade process.

Table 9: CRS Compatibility Matrix

Switch Fabric	RP/DRP	MSC/FP/LSP	PLIMs
CRS-16-FC/S	RP-A (CRS-16-RP), RP-B (CRS-16-RP-B), DRP-B (CRS-DRP-B)	CRS-MSC-B	1OC768-DPSK/C 1OC768-ITU/C 1OC768-POS-SR 4-10GE-ITU/C 8-10GBE CRS1-SIP-800 4-10GE 42-1GE 20-1GE-FLEX 2-10GE-WL-FLEX 4-10GBE-WL-XFP 8-10GBE-WL-XFP
CRS-16-FC140/S	RP-A (CRS-16-RP), RP-B (CRS-16-RP-B), DRP-B (CRS-DRP-B)	CRS-MSC-B	1OC768-DPSK/C 1OC768-ITU/C 1OC768-POS-SR 4-10GE-ITU/C 8-10GBE CRS1-SIP-800 4-10GE 42-1GE 20-1GE-FLEX 2-10GE-WL-FLEX 4-10GBE-WL-XFP 8-10GBE-WL-XFP
	PRP (CRS-16-PRP-6G, CRS-16-PRP-12G)	CRS-MSC-140G	14X10GBE-WL-XFP 20X10GBE-WL-XFP 1x100GBE
	PRP (CRS-16-PRP-6G, CRS-16-PRP-12G))	CRS-FP140	14X10GBE-WL-XFP 20X10GBE-WL-XFP 1x100GBE
	PRP (CRS-16-PRP-6G, CRS-16-PRP-12G)	CRS-LSP	14X10GBE-WL-XFP 20X10GBE-WL-XFP 1x100GBE

Switch Fabric	RP/DRP	MSC/FP/LSP	PLIMs
CRS-16-FC400/S	PRP (CRS-16-PRP-6G, CRS-16-PRP-12G)	CRS-MSC-X (400G)	4x100GE-LO 40x10GE-WL02x100GE-FLEX-40
		CRS-FP-X (400G)	
		CRS-LSP-X (400G)	



APPENDIX B

Preliminary Site Survey

Preliminary Site Survey

This appendix contains a sample preliminary site survey that you should complete before planning a detailed site survey. This preliminary survey ensures that the basic system requirements have been completed or are underway before detailed site plans are completed.

The following table is a sample preliminary site survey.

Table 10: Sample Preliminary Site Survey

Preliminary Site Survey	
Order Information	
Sales order number:	
Estimated shipping date:	
Site ready date:	
Installation date:	
Site Location and Address	
Company name:	
Site address:	
Shipping address:	
Building or computer room access:	
Special instructions:	

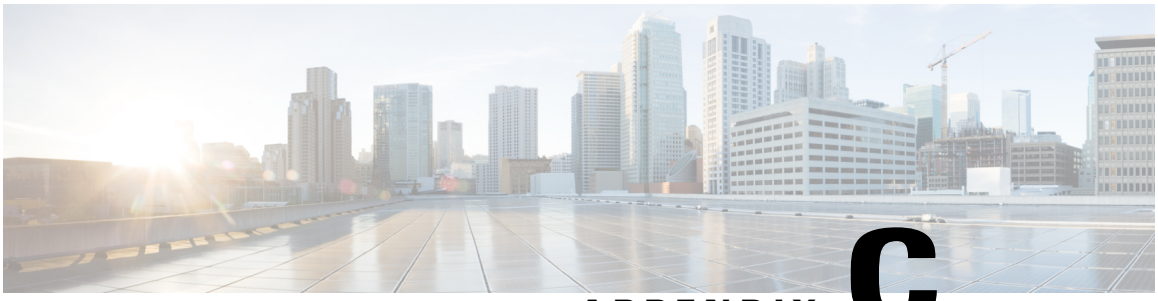
Preliminary Site Survey	
Hours and days of operation:	
Site Survey Contacts	
Primary Contact	
Name:	
Title:	
Phone number:	
Mobile phone number:	
Fax number:	
Pager number:	
E-mail address:	
Secondary Contact	
Name:	
Title:	
Phone number:	
Mobile phone number:	
Fax number:	
Pager number:	
E-mail address:	
Delivery and Installation Constraints	
Is there a loading dock available to unload the equipment at this site?	
Is the path to the installation area unobstructed? If not, can special arrangements be made to get the equipment to the installation area? Describe them.	
On what floor is the installation?	

Preliminary Site Survey	
If it is on a floor other than the ground floor, is there a freight elevator available? Note if the equipment will have to be brought up a flight of stairs.	
Is there someone on site during working hours to accept delivery of the materials? If not, list the times this person would be available.	
For more information, see Shipping and Receiving, on page 43.	
Floor Mounting	
How many Cisco CRS 16-Slot Line Card Chassis Enhanced routers will be installed? Is there floor space available for all of the chassis?	
Does the floor meet the routing system floor-loading requirements?	
Can the primary or secondary chassis mounting locations be used to secure the chassis to the floor, or will an outrigger kit be required?	
Make a sketch of the area where the chassis is to be installed and note the chassis location.	
For more information, see Space Planning, on page 17.	
Power	
Is AC or DC power available for the chassis? Is there a connection point on the panel for the chassis?	
Is there a fuse access panel (FAP) available for the equipment? Provide a connection point on the fuse access panel for each chassis.	
Will a fuse access panel be installed in time for the routing system installation? Provide a date when the FAP will be installed.	
Is the FAP in the same room as the chassis?	
Is there an AC power outlet (220 V or 110 V) located within 10 feet of each chassis for PCs and test equipment?	
Is there proper grounding for the equipment? If not, when will the grounding be available? Provide a connection point for the grounding.	

Preliminary Site Survey	
Are there any restrictions when the equipment can be powered on or when electrical work can be done? If so, describe them.	
Are there special requirements for power or power cables (for example, a different wire gauge, and so on)? If so, describe them.	
For more information, see Power and Cooling Requirements, on page 25.	
Air Conditioning	
Does the site have the air conditioning capacity to handle the routing system? If not, note what will be done to rectify the lack of adequate cooling.	
Describe the air conditioning at the site.	
For more information, see Power and Cooling Requirements, on page 25.	
System Interconnection Cabling (if applicable)	
Has the chassis-to-chassis interconnection cabling been considered?	
Control Plane, BITS, and Alarm Interfaces	
Will the facility building integrated timing source (BITS) be used? Has the cabling been considered?	
Will the chassis be connected to an external alarm system? Has the cabling been considered?	
Supported Data Interfaces	
Will the routing system be connected to OC-3/STM-1 POS circuits? How many ports?	
Will the routing system be connected to OC-48/STM-16 POS or DPT circuits? How many ports?	
Will the routing system be connected to OC-192/STM-64 POS or RPR XFP circuits? How many ports?	
Will the routing system be connected to OC-768/STM-256 POS circuits? How many ports?	
Will the routing system be connected to Gigabit Ethernet (GE) or 10-GE circuits? How many ports?	

Preliminary Site Survey	
Will the routing system be connected to 100-GE circuits? How many ports?	
Cable Plant	
Are there connection points on the fiber distribution panel for all optical cables connecting to the routing system?	
Will fiber jumpers be provided? If not, measure and record the length of fiber jumper required to complete the installation, and place the order.	
What type of fiber connector is used at the site?	
If attenuation is required, will attenuators be provided? If not, who will provide the attenuators?	

Preliminary Site Survey



APPENDIX C

System Specifications

This appendix contains tables that list the specifications for the main components of the Cisco CRS 16-Slot EC Line Card Chassis.

Note For a complete list of cards supported in the LCC, go to the Cisco Carrier Routing System Data Sheets at: http://www.cisco.com/en/US/products/ps5763/products_data_sheets_list.html

The appendix includes the following topics:

Line Card Chassis Specifications

The following table lists the specifications for the LCC.

Table 11: Cisco CRS 16-Slot EC Line Card Chassis Specifications

Supported Cards and Modules	16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter	
Chassis Dimensions		

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
Height	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	80 in. (203.2 cm) as shipped[84]

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	in. (213.4 cm) as installed

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	(with two power shelves)

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
Width	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
	23.6 in. (59.9 cm) (without

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	36 in. (91.5 cm)

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	with PDU and blanks

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	in. (80.8 cm) with

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	optional wide cable management

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	troughs

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
Depth	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	36 in. (91 cm) without doors

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	and other cosmetics 39.7 in.

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	(101 cm) with front

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	and rear doors 40.3 in. (102.2

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	cm) with optional wide

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	cable management troughs

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
Floor space requirement	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	Chassis: 7.5 sq ft (.7 sq m)

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
	Aisle spacing to install

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
	chassis (front): 48 in. (122

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	cm)

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
	Aisle spacing to service

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	FRUs (front): 36 in. (91 cm)

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
	Aisle spacing to service

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	FRUs (rear): 36 in. (91 cm)

Supported Cards and Modules	16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter
Chassis	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
Chassis shipping weight	993 lb (450.42 kg)

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	1300 lb (589.67 kg)

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
Chassis in shipping crate	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
with pallet	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
	1101 lb (499.4 kg)

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
Chassis with power shelves	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
only, no power modules	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	1180 lb (535.2 kg)

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
Chassis with power shelves,	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
power modules, alarm module	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
	1535 lb (696.3 kg)

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
Chassis, fully loaded with	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
cards, without cosmetics	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	1650 lb (748.43 kg

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
Chassis, fully loaded with	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
cards and cosmetics (doors,	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
panels, grilles, and so on)	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
	1720.7 lb (780.5 kg)

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
Chassis, fully loaded with	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
cards and cosmetics (doors,	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
panels, grilles, and so on), AC	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
Wye PDU, and brackets	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
	1720.7lb (780.5 kg)

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
Chassis, fully loaded with	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
cards and cosmetics (doors,	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
panels, grilles, and so on), AC	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
Delta PDU, and brackets	

Supported Cards and Modules	16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter
Floor Loading	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
Chassis footprint	7.2 sq ft (6689 sq cm)

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
Floor contact area	5.88 sq ft (5462 sq ft)

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
Maximum floor loading	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	max floor loading without

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	cosmetics and doors 263.6

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
	lb/sq ft

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	max floor loading with

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	cosmetics and doors 292.6

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	lb/sq ft

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
Chassis Cooling	2 fan trays, push-pull configuration

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
Chassis airflow	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
	2700 cubic ft/ minute (76,455

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	liters)

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards) 16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP 8 switch fabric cards (SFCs) 2 route processor (RP) cards or 2 peformance route processor (PRP) cards 2 fan trays 1 air filter**
Power shelf airflow	

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	200 cubic ft/ minute (5660

Supported Cards and Modules	**16 modular services cards (MSCs), forwarding processor (FP) cards, or label switch processor (LSP) cards (line cards)** **16 physical layer interface modules (PLIMs), one for each MSC, FP, or LSP** **8 switch fabric cards (SFCs)** **2 route processor (RP) cards or 2 peformance route processor (PRP) cards** **2 fan trays** **1 air filter**
	liters)

Power Specifications

The following table lists the power specifications for the LCC.

Table 12: Line Card Chassis Power Specifications

Description	Value
Power shelves	2 AC or 2 DC power shelves (Cannot mix AC and DC power shelves.)
DC power shelf	Supports up to 8 DC power modules (PMs) 6 PMs are shipped per shelf
AC power shelf	Supports up to 6 AC power modules (PMs) 5 PMs are shipped per shelf
Maximum Input Power	
DC, chassis fully loaded	19,091 Watts

Description	Value
AC, chassis fully loaded	19,565 Watts
Maximum Output Power	
DC, chassis fully loaded	16.80 kW
AC, chassis fully loaded	18.00 kW
Power Redundancy	
DC	2N: Up to 8 “A” battery plant feeds and up to 8 “B” battery plant feeds
AC	2N: Up to 6 “A” AC single-phase power sources and up to 6 “B” single-phase AC power sources required.
DC Input	

Description	Value
Nominal input voltage	–48 VDC North America–60 VDC International Range: 40 to –72 VDC
Input current	50 A max at –48 VDC40 A max at –60 VDC60 A at –40 VDC (maximum)
AC Input	Single-phase
Nominal input voltage	200 to 240 VAC (range 180 to 264 VAC)
Nominal line frequency	50/60 Hz (range 47 to 63 Hz)

Description	Value
Recommended AC service	20 A (North America) dedicated branch circuit16 A (International) dedicated branch circuit
AC power cord length	167 in. (4.25 m)

Line Card Chassis Environmental Specifications

The following table lists the environmental specifications for the line card chassis.

Table 13: Line Card Chassis Environmental Specifications

Description	Value
Temperature	Operating, nominal: 41° to 104°F (5° to 40°C) Operating, short-term: 23° to 122°F (–5° to 50°C) **Note** Short-term refers to a period of not more than 96 consecutive hours and a total of not more than 15 days in 1 year. This refers to a total of 360 hours in any given year, but no more than 15 occurrences during that 1-year period. Nonoperating: –40° to 158°F (–40° to 70°C)
Humidity	Operating: 5 to 90% noncondensing Nonoperating: 5 to 93% noncondensing, short-term operation
Altitude	–197 to 5906 ft (–60 to 1800 m) at 122°F (50°C), short-term Up to 13,123 ft (4000 m) at 104°F (40°C) or below

Description	Value
Heat dissipation	49,134 BTU per hour (maximum) DC **Note** Heat dissipation from the modular configuration DC power system based on maximum output power capacity at 90% efficiency. 56,641 BTU per hour—(maximum) AC **Note** Heat dissipation from the modular configuration AC power system based on maximum output power capacity at 92% efficiency. Depending on the hardware deployed at your site, your system may not consume or be capable of consuming the maximum power supplied by the power system.
Air exhaust temperature	140°F (60°C)—at room temperatures of 95 to 102°F (35 to 39°C) 158°F (70°C)—maximum exhaust temperature on a fully loaded system during worst-case operating conditions (50°C and 6000 ft altitude **Note** Air temperature rise is 68°F (20°C) on a fully loaded system with fans running at maximum speed (5150 RPM).
Air velocity (at exhaust)	1000 ft/min (5.1m/s) at 3500 rpm 2250 ft/min(11.4m/s) at 7500 rpm **Note** Software controls the speed of the fans based on measurements from the chassis thermal sensors.
Sound power level(AC and DC power)	Fan speed 3500 RPM, temperature 80°F (27°C): 77.2 dB—modular configuration power Fan speed 5150 RPM, temperature 104°F (40°C): 88.8 dB—modular configuration power
Shock and vibration	Designed and tested to meet the NEBS shock and vibration standards defined in GR-63 Issue 3 March 2006.

Regulatory, Compliance, and Safety Specifications

For information about the regulatory, compliance, and safety standards to which the Cisco CRS Series system conforms, see *Regulatory Compliance and Safety Information for the Cisco CRS Carrier Routing System* .