Cisco CRS Carrier Routing System 4-Slot Line Card Chassis Site Planning Guide

First Published: 2011-01-31

Last Modified: 2013-11-11

Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
http://www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 527-0883

CONTENTS

CHAPTER 3 **Planning for Installation** 13

Preface

This preface explains the objectives and intended audience for this *Cisco CRS Carrier Routing System 4-Slot Line Card Chassis Site Planning Guide* (referred to in this document as the site planning guide). This preface also decribes the document organization and the conventions used in the document.

Objectives

This guide describes the basic facilities requirements, such as floor space, power requirements, environmental requirements, and so on, for the Cisco CRS 4-Slot Line Card Chassis (LCC). This guide is intended to help you in planning the site where the chassis will be installed. It should be used with Cisco Systems, Inc. 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, rack-mounting, power, cooling, cabling, delivery, and storage, for the delivery and installation of a Cisco CRS 4-Slot LCC.

Organization

This document contains the following chapters:

Title	Description
Cisco CRS 4-Slot Line Card Chassis Overview	Describes the Cisco CRS 4-Slot LCC and its components.
Planning for Delivery	Provides information about chassis space requirements and other site preparation details related to the chassis delivery.
Planning for Installation	Describes the power, cooling, and other requirements for the chassis.
Preliminary Site Survey	Contains a sample preliminary site survey in which you can enter information about the installation site and site-preparation process.
Cisco CRS 4-Slot Line Card Chassis System Specifications	Lists various 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.

Convention	Description
[ ]	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 Documentation

This section refers you to other documentation that contains complete planning, installation, and configuration information.

The documentation listed below is available online.

- *Cisco CRS Carrier Routing System 4-Slot Line Card Chassis System Description*
- *Cisco CRS Carrier Routing System 4-Slot Line Card Chassis Installation Guide*
- *Cisco CRS Carrier Routing System 4-Slot Line Card Chassis Unpacking, Moving, and Securing Guide*
- *Cisco CRS Carrier Routing System Ethernet Physical Layer Interface Module (PLIM) Installation Note*

- *Cisco CRS Carrier Routing System Packet-over-SONET Physical Layer Interface Module (PLIM) Installation Note*
- *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*

Changes to This Document

This table lists the technical changes made to this document since it was first created.

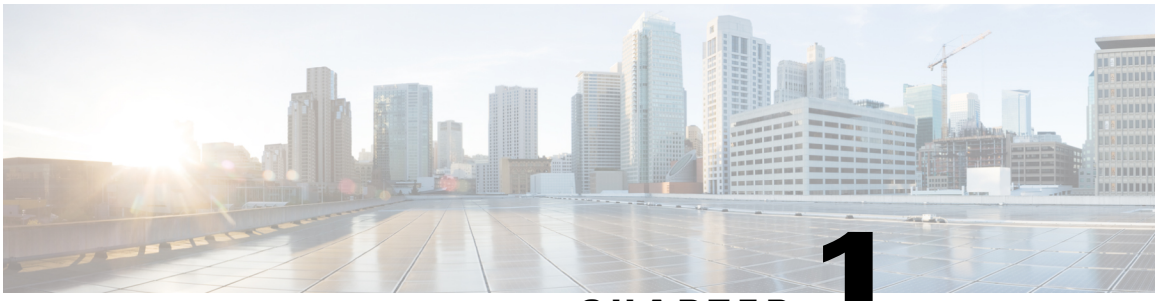
Table 1: Changes to This Document

Date	Summary
August 2011	Minor editorial change to Figure 1-1 to correct a caveat.
April 2011	Added information about new performance route processor (PRP) cards (product IDs: CRS-8-PRP-6G, CRS-8-PRP-12G). Minor editorial changes were also made.
October 2010	Added information about the new MSC-140G and FP140 cards. Minor editorial changes were also made.
March 2008	Minor editorial changes.
March 2007	Added DC power information where appropriate, made technical corrections in various chapters, and updated the chassis system specifications in *Cisco CRS 4-Slot Line Card Chassis System Specifications*.
November 2006	Initial release of the document.

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 4-Slot Line Card Chassis Overview

This guide describes how to plan and prepare your facilities for the delivery and installation of a Cisco CRS Carrier Routing System 4-Slot Line Card Chassis (LCC). Because the installation of the LCC may require space, rack-mounting, power, and cooling modifications to a facility, site planning should be done in advance of the scheduled delivery of the chassis.

Cisco CRS 4-Slot Line Card Chassis Overview

This chapter describes the Cisco CRS 4-slot LCC and its main components. The following sections are included:

Note Throughout the remainder of this guide, the Cisco CRS Carrier Routing System 4-Slot LCC is referred to as the Cisco CRS 4-slot LCC.

The Cisco CRS 4-slot LCC documentation set is workflow-based. There are three core documents that describe the processes required to successfully plan for and install the chassis:

See (add xref) for a complete listing of Cisco CRS 4-slot LCC documentation.

1. *Cisco CRS Carrier Routing System 4-Slot Line Card Chassis Site Planning Guide* (this guide)

   Use this guide in advance of receiving the chassis to confirm that you have the needed space, tools, utilities, manpower, etc. that are needed to perform the steps in the unpacking, moving, and securing guide and the installation guide.

2. *Cisco CRS Carrier Routing System 4-Slot Line Card Chassis Unpacking, Moving, and Securing Guide*

   This guide is included with the chassis shipment. It includes all Cisco CRS 4-slot LCC unpacking, moving, and securing information.

3. *Cisco CRS Carrier Routing System 4-Slot Line Card Chassis Installation Guide*

   This guide is used to initially install the chassis and describes how to remove and install field replaceable units (FRUs).

   See (add xref) for a complete listing of Cisco CRS 4-slot LCC documentation.

Hardware Overview

The Cisco CRS router is a highly scalable routing platform designed for efficient service-provider point-of-presence (POP) evolution as the IP network grows into a multiservices network. The Cisco CRS router is available in 4-slot, 8-slot, 16-slot, and multishelf configurations.

The introduction of the Cisco CRS 4-slot LCC allows service providers to utilize the power and features of a Cisco CRS chassis, but without the space and power requirements associated with the larger versions of the chassis. The Cisco CRS 4-slot LCC is a mechanical enclosure that contains four slots for modular services cards (MSCs) or forwarding processor (FP) cards, and associated physical layer interface modules (PLIMs), plus four slots for the switch fabric cards (SFCs).

The router is built around a scalable, distributed three-stage Benes switch fabric and variety of data interfaces. The data interfaces are contained on physical layer interface modules (PLIMs) that are mated in the Cisco CRS 4-slot LCC to an associated MSC or FP. MSCs and FPs, which are also referred to as line cards, are cross-connected to each other through the switch fabric.

The Cisco CRS 4-slot LCC is installed in a standard external rack and contains its own power and cooling systems. The chassis also contains route processor (RP) cards that perform routing-protocol calculations. The RPs distribute forwarding tables to the modular services cards MSCs, provide a control path to each MSC and FP for system monitoring functions, and contain hard disks for system and error logging. RPs plug into two dedicated slots in the Cisco CRS 4-slot LCC.

Note The Cisco CRS 4-slot LCC is described in greater detail in the *Cisco CRS Carrier Routing System 4-Slot Line Card Chassis System Description* .

Chassis Components

This section lists the main components of the Cisco CRS 4-slot LCC. It primarily identifies the components that are considered field-replaceable units (FRUs). Where additional detail is useful, it also identifies subassemblies that are not field replaceable.

The Cisco CRS 4-slot LCC contains the following components:

- Up to four MSCs (or FPs)and four PLIMs. An MSC (or FP) and a PLIM are an associated pair of cards that mate through the chassis midplane. The line card (MSC or FP) provides the forwarding engine for Layer 3 routing of user data, and the PLIM provides the physical interface and connectors for the user data.

Three versions of MSC exist (CRS-MSC, CRS-MSC-B, and CRS-MSC-140G). There are two versions of forwarding processor (FP) cards (CRS-FP40 and CRS-FP-140).

Each MSC and FP can be associated with several different PLIMs, which provide different interface speeds and technologies. The PLIM types available are:

- ◦ Packet-over-SONET/SDH (POS)
  ◦ 10-Gigabit Ethernet PLIMs
  ◦ 100-Gigabit Ethernet PLIM

For complete PLIM information, see the following documents:

- ◦ Cisco CRS Carrier Routing System Packet-over-SONET/SDH Physical Layer Interface Module Installation Note
  ◦ Cisco CRS Carrier Routing System Ethernet Physical Layer Interface Module Installation Note.

- Optional interface solution (to PLIMs) is also available. SPA interface processors (SIPs) and shared port adapters (SPAs) can be installed instead of PLIMs. An SIP is a carrier card that is similar to a PLIM and inserts into a Cisco CRS 4-slot LCC slot and interconnects to an MSC like a PLIM. Unlike PLIMs, SIPs provide no network connectivity on their own. An SPA is a modular type of port adapter that inserts into a subslot of a compatible SIP carrier card to provide network connectivity and increased interface port density. An SIP can hold one or more SPAs, depending on the SIP type and the SPA size. POS/SDH and Gigabit Ethernet SPAs are available. For complete SIP and SPA information, see the Cisco CRS Carrier Routing System SIP and SPA Hardware Installation Guide.
- Chassis midplane. The midplane connects MSCs to their associated PLIMs and allows an MSC to be removed from the chassis without having to disconnect the cables that are attached to the associated PLIM. The midplane distributes power, connects the MSCs or GFPs to the switch fabric cards (SFCs), and provides control plane interconnections. The midplane is not field replaceable by the customer.
- Two RP cards. The RPs provide the intelligence of the system by functioning as the Cisco CRS 4-slot LCC system controller and performing route processing. Only one RP is active at a time. The second RP acts as a standby RP, serving as a backup if the active RP fails. The RP also monitors system alarms and controls the system fans. LEDs on the front panel indicate active alarm conditions.

A Performance Route Processor (PRP) is also available for the Cisco CRS 4-slot line card chassis. Two PRPs perform the same functions as RPs, but provide enhanced performance for both route processing and system controller functionality.

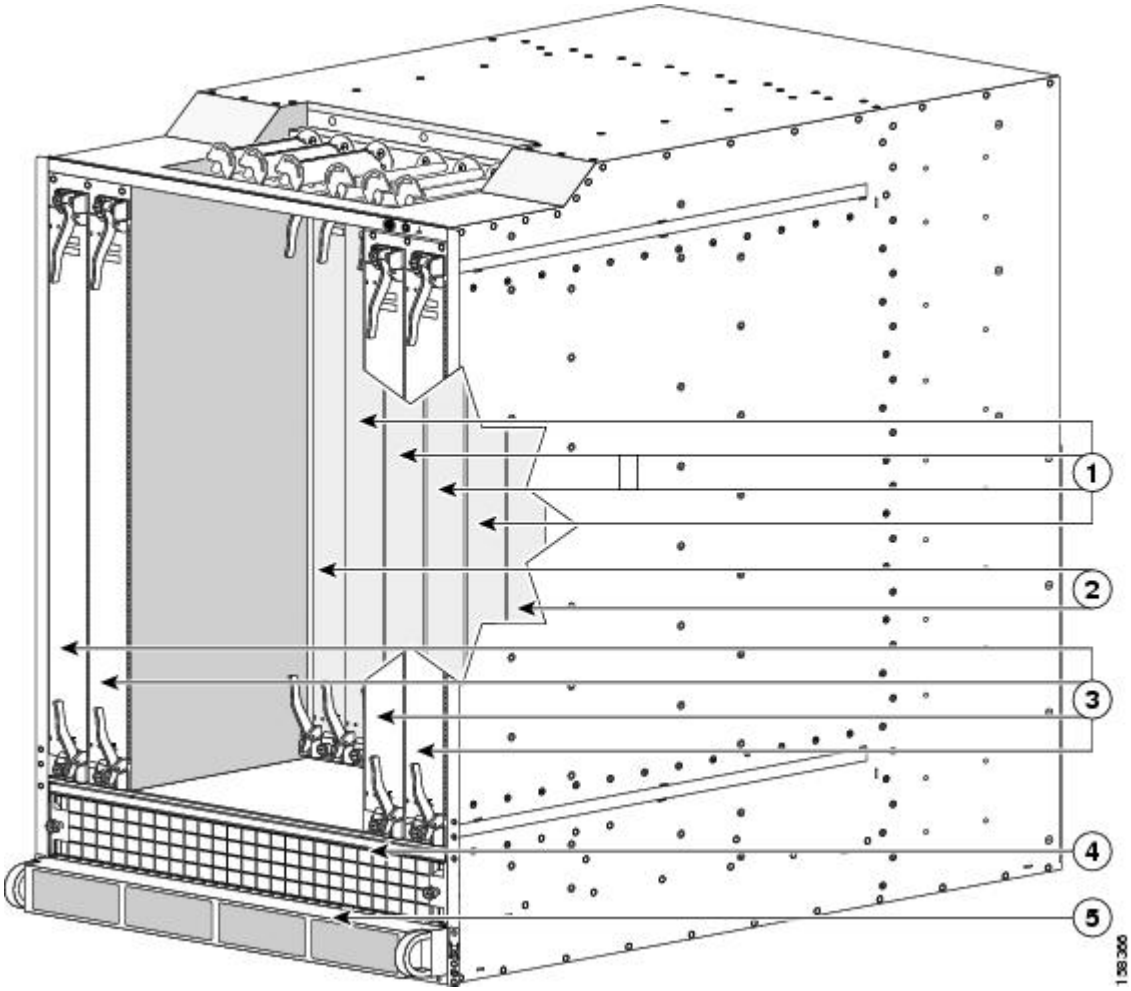
Note A chassis may not be populated with a mix of RP and PRP cards. Both route processor cards should be of the same type (RP or PRP).

- Four SFCs. These cards provide a three-stage Benes switch fabric for the system. The switch fabric receives user data from one line card (MSC or FP) and PLIM pair and performs the switching necessary to route the data to the appropriate egress line card and PLIM pair. The Cisco CRS 4-slot LCC SFCs provide all three stages of the three-stage Benes switch fabric.
- One AC power shelf with four AC rectifiers in each power shelf. The power shelf and AC rectifiers provide 4,000 watts of redundant input power for the chassis.
- One DC power shelf with four DC power supplies. The DC power system provides 4,000 watts to power the chassis.
- Fan tray. The fan tray contains fans that push and pull air through the chassis. A removable air filter is located above the power shelf in the front of the chassis.

The front of the chassis contains the RPs, MSCs, FPs, and PLIMs. This is where user data cables attach to the PLIMs and where cool air enters the chassis. The rear of the chassis contains the fan tray and the SFCs.

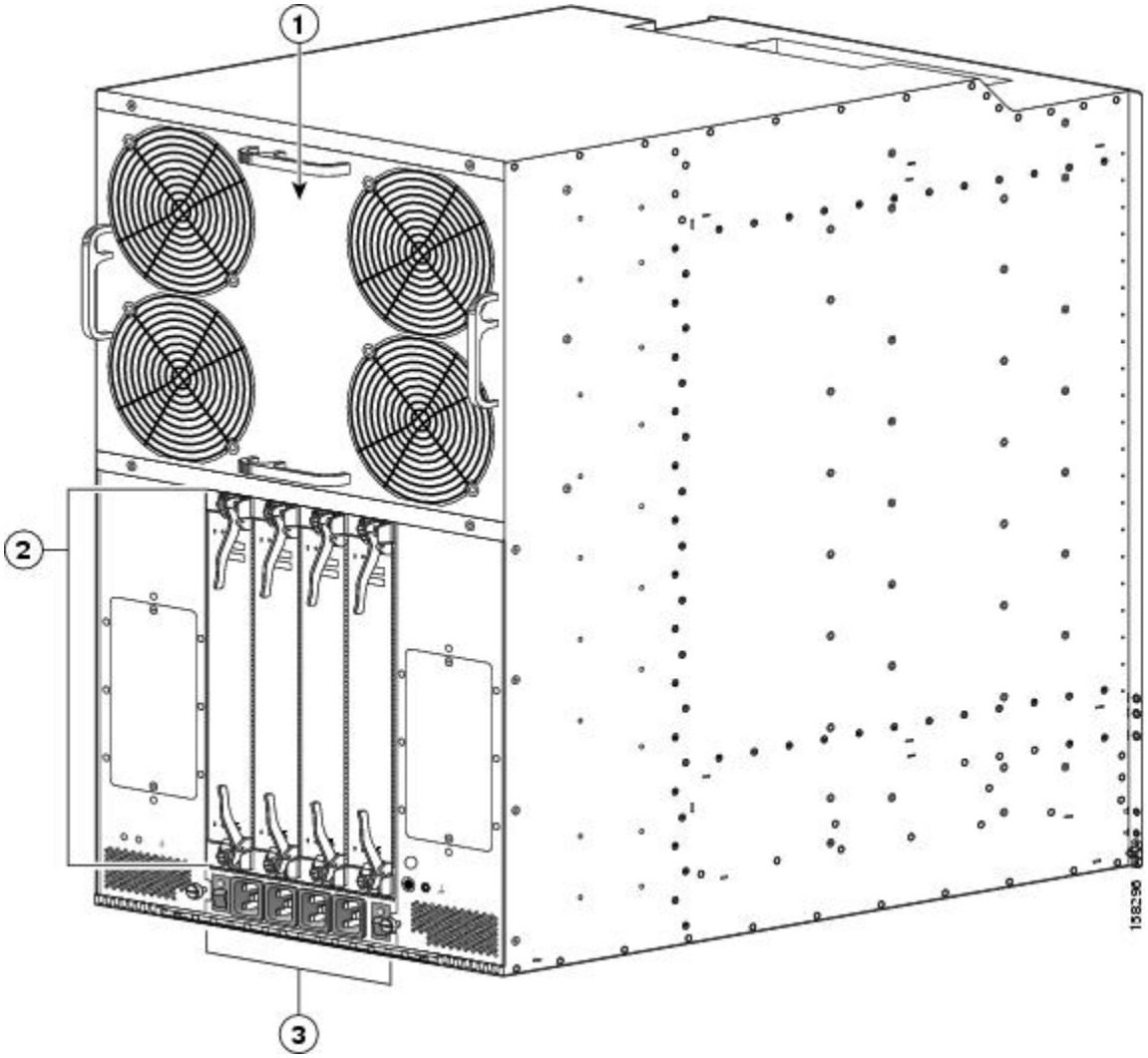
The figure below and Figure 2: Rear of Cisco CRS 4-Slot Chassis, on page 5 show the front and rear views of the Cisco CRS 4-slot LCC.

Figure 1: Front of Cisco CRS 4-Slot Chassis



1	PLIM slots	4	Air intake
2	RP slots	5	Power supplies
3	MSC slots		

Figure 2: Rear of Cisco CRS 4-Slot Chassis



1	Fan tray	2	Switch fabric card (half-height) slots
3	AC input power receptacles and power switches		

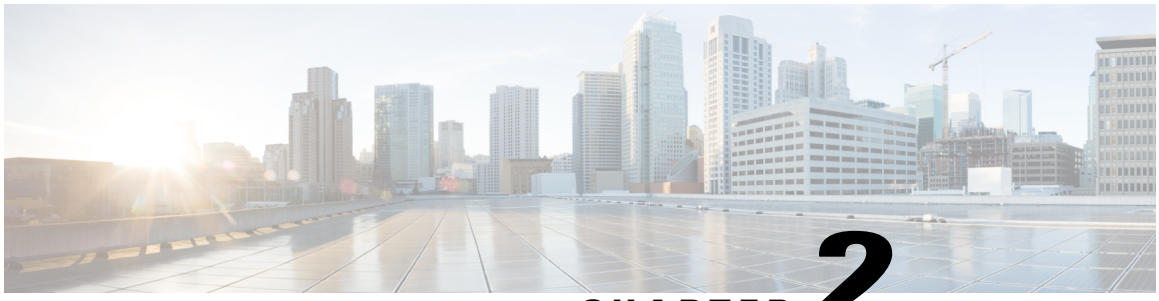
Overview of Site Planning Steps

Table 1 lists the steps required to prepare your site for the delivery and installation of a Cisco CRS 4-slot line card chassis. For information about a particular task, see the appropriate chapter or section of this site planning guide.

See the Appendix Preliminary Site Survey for a sample of the preliminary site survey that you should complete before you prepare a detailed site survey.

Table 2: Cisco CRS 4-Slot Line Card Chassis Installation Checklist

Site Planning Steps	See	Check
1. Confirm that the chassis delivery site meets delivery space requirements	Chassis Dimensions and Weights, on page 7	
2. Determine and gather the required unpacking tools.	Required Unpacking Tools, on page 8	
3. Determine the route from the delivery site to the installation site and confirm space and manpower needs.	Verifying the Move Path , on page 11	
4. Determine and gather the required moving tools.	Required Moving Tools, on page 10	
5. Confirm that the installation site meets basic space requirements.	Planning for Space, on page 17	
6. Confirm that the installation site meets basic power and grounding requirements.	Planning for Power, on page 21	
7. Confirm that the installation site meets basic cooling and airflow requirements.	Airflow, on page 25 "Environmental Specifications" section	
8. Confirm that the installation site meets basic cooling and airflow requirements.	Chassis Cable-Management, on page 27 Planning for High Availability, on page 27	



CHAPTER 2

Planning for Delivery

This chapter describes the site planning steps related to the delivery of the Cisco CRS 4-Slot LCC.

Note The topics in this section are for general planning purposes only. The tasks involved are covered in detail in the Cisco CRS Carrier Routing System 4-Slot Line Card Chassis Unpacking, Moving, and Securing Guide that is shipped with the LCC.

The following sections are included:

Planning for Delivery

This chapter describes the site planning steps related to the delivery of the Cisco CRS 4-Slot LCC. The following sections are included:

Note The topics in this section are for general planning purposes only. The tasks involved are covered in detail in the Cisco CRS Carrier Routing System 4-Slot Line Card Chassis Unpacking, Moving, and Securing Guide that is shipped with the LCC.

Planning to Receive the Chassis

Before installing the LCC, it must be received at your shipping dock or other delivery location. This section provides the specifications that your shipping and receiving team may find useful prior to delivery of the LCC.

Chassis Dimensions and Weights

The two most important factors in planning for the delivery of the LCC are the chassis dimensions and weights (both packaged and unpackaged). The table below provides the dimensions and weight of a packaged LCC. Table 4: Unpackaged Chassis Dimensions, on page 8 provides the dimensions and weight of an unpackaged LCC.

Table 3: Packaged Chassis Dimensions

Weight	**338 lb (153.3 kg)—Chassis including packaging and pallet**
Dimensions	Height: 42 in. (106.6 cm) Width: 24.5 in. (62.2 cm) Length: 39.75 in. (100.9 cm)

Table 4: Unpackaged Chassis Dimensions

Weight	**260 lb (118 kg)—As shipped with fan tray, power shelf, and card slot blanks** **380 lb (172 kg)—Total weight with all SFCs, MSCs, PLIMs, and RPs installed**
Dimensions	Height: 30 in. (76.2 cm) Width: 17.65 in. (44.8 cm)—Without cosmetics Depth: 30.28 in. (76.9 cm)

Planning to Unpack the Chassis

To unpack the chassis, you need space, tools, and sufficient manpower. Use the specifications in Table 3: Packaged Chassis Dimensions, on page 8 to determine how much space and manpower you need to unpack a packaged chassis.

Required Unpacking Tools

The following tools are required to unpack the chassis:

- Medium (Number 2) Phillips screwdriver
- 9/16-inch (15 mm) socket wrench
- Scissors or wire cutters
- ESD-preventive wrist strap
- Antistatic mat or bag

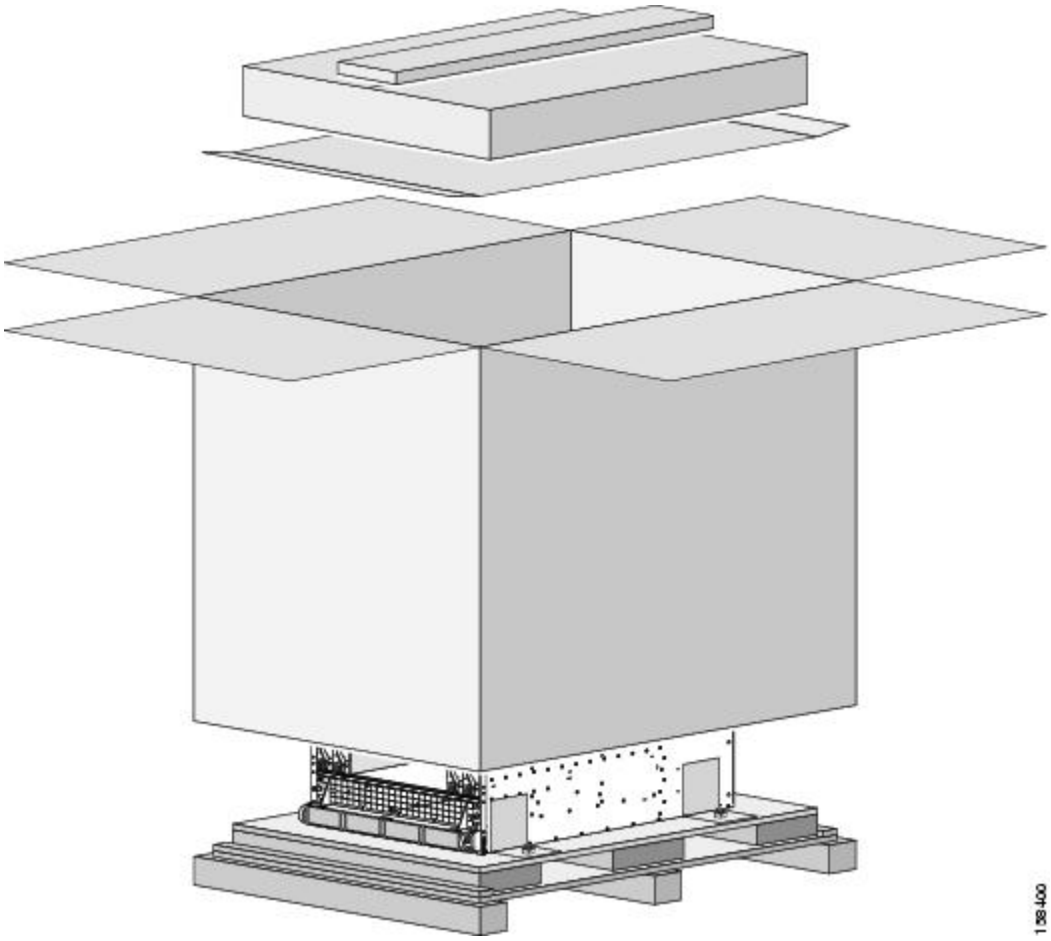
Note Removing the packaging prior to moving the Cisco CRS 4-slot LCC is optional. The packaging can be removed either at the loading dock or at the installation site. However, we recommend unpacking the chassis at the installation site (if feasible) to reduce the possibility of damage to the chassis.

Shipping Crate and Pallet

The LCC is shipped on a pallet and arrives inside a polyethylene bag enclosed in a box, held in place by plastic bands (see the below figure). For complete details on the contents of each crate, see the shipping and parts identification label on the crate.

Caution Do not stack the LCC shipping crate, becaue serious damage to the chassis can occur.

Figure 3: Cisco CRS 4-Slot Line Card Chassis in Original Packaging



Unpacking Considerations

Consider the following as you plan for unpacking the chassis:

- Make sure that enough room exists at the loading dock or installation site to unpack the chassis. If you plan to store the chassis before installation, make sure that you have a large enough area. You should store the chassis in its shipping crate until you are ready to install it.

- Determine if you are going to unpack the chassis at the loading dock or installation site. Consider the following:
  - Are the corridors and aisles from the loading dock to the installation site wide enough for the moving device and the chassis packed in its crate? (See Table 3: Packaged Chassis Dimensions, on page 8.) If not, consider unpacking the chassis at the loading dock.
  - If corridors and aisles are wide enough and there is enough space at the installation site to unpack the chassis, we recommend leaving the chassis in its packaging during the move.
  - If the corridors and aisles are not wide enough, the packaging needs to be removed at the loading dock. Doing so makes the chassis shorter and narrower while remaining on the pallet.
- Consider how you will move the chassis components from the shipping dock to the installation site.

Planning to Move the Chassis

As with unpacking, moving the LCC from the loading dock requires space, tools, and manpower. Use the specifications in Table 3: Packaged Chassis Dimensions, on page 8 and Table 4: Unpackaged Chassis Dimensions, on page 8 to determine how much space and manpower you will need to move the chassis.

Required Moving Tools

The following tools are required to move the chassis:

- Mechanical lifting device with a lifting capacity exceeding 500 lb (227 Kg).
- Piece of cardboard roughly the width of the chassis.

Moving Considerations

When planning your LCC installation, you must consider how the chassis will be moved from the shipping dock to the site where the chassis is to be installed. This section provides information about the things to consider as you plan for transportation of the chassis from the loading dock to the installation site.

The line card chassis is shipped in a crate that reduces the potential for product damage during routine material handling and shipment. To protect the chassis:

- Transport the chassis in its original packaging whenever possible, and make sure that the chassis is transported and stored in an upright position.
- If you plan to store the chassis before the installation, leave it in its original shipping container to prevent accidental damage.

Consider the route you intend to use to move the chassis from the loading dock to the installation site. See Table 5: Chassis Move Path Specifications, on page 12 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 chassis?
  - Can freight elevators support the weight of the chassis and the moving device?
  - Are elevators tall and wide enough for the chassis (with or without the shipping crate)?
- Are there any ramps in the transport route? If so, does the ramp create an incline that impedes transportation of the chassis on its pallet?
- 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 (for example, forklift). See Table 3: Packaged Chassis Dimensions, on page 8 for packaged chassis dimensions.
- 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, items on the floor, and so on).
- Determine what type of moving device you will use (such as a forklift or similar moving device) to move the chassis. The following section describes the things to consider about a moving device:

Using a Forklift to Move the Chassis—Things to Consider

If you plan to use a forklift or similar moving device (such as a safety hand truck or pallet jack) to move the chassis, consider the following:

It must be capable of preventing the chassis from tipping. For example, you could use a safety hand truck with retractable safety leg wheels and a security strap.

We recommend that you leave the chassis in its shipping crate and pallet for moving.

Make sure that the moving device can support the weight of the chassis and its shipping crate (see Table 3: Packaged Chassis Dimensions, on page 8).

Make sure that hallways and doorways (including elevators) are high and wide enough for the shipping crates and moving device. See Table 3: Packaged Chassis Dimensions, on page 8 for packaged chassis dimensions.

Verifying the Move Path

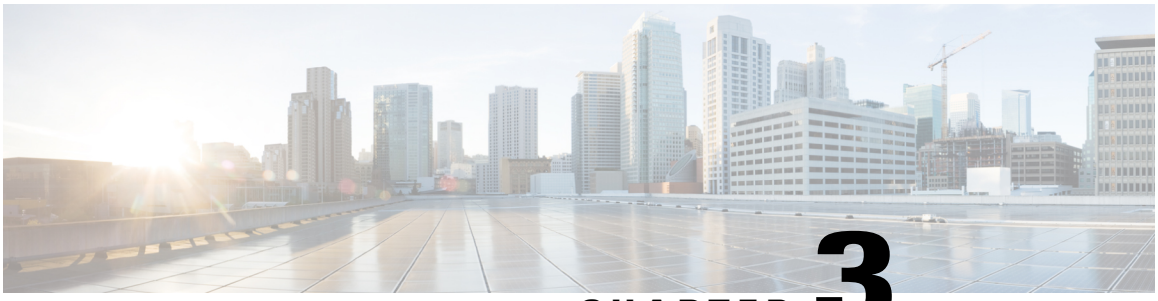
Before moving the chassis, it is critical that you verify that the path that you are planning to use to move the chassis to its final location can accommodate the chassis size and weight and the restrictions of the chassis when using the moving device.

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

Table 5: Chassis Move Path Specifications

Description	Value
Height	30 in. (76.2 cm)
Depth	30.3 in. (77 cm)
Width	18.5 in. (47 cm)
Weight of chassis as shipped	338 lb (153.3 kg)
Maximum incline	10 degrees
Maximum curb height	1.00 in. (2.54 cm)

Note These specifications include a gap of 6 in. (15 cm) on each side of the chassis to facilitate moving the chassis.



CHAPTER 3

Planning for Installation

This chapter describes how to plan for the installation of the Cisco CRS 4-slot line card chassis (LCC).

Note The Cisco CRS Carrier Routing System 4-Slot Line Card Chassis Unpacking, Moving, and Securing Guide ships with your chassis and is the most up-to-date resource for unpacking and moving the chassis, and securing it to its operational location.

The following sections are included:

Planning for Installation

This chapter describes how to plan for the installation of the Cisco CRS 4-slot line card chassis (LCC). The following sections are included:

Note The Cisco CRS Carrier Routing System 4-Slot Line Card Chassis Unpacking, Moving, and Securing Guide ships with your chassis and is the most up-to-date resource for unpacking and moving the chassis, and securing it to its operational location.

Required Securing and Installation Tools

The following tools are required to secure and install the Cisco CRS 4-slot LCC:

- ESD-preventive wrist strap
- Large flat-blade screwdriver
- Medium flat-blade screwdriver
- Small flat-blade screwdriver
- Large (Number 3) Phillips screwdriver

- Medium (Number 2) Phillips screwdriver
- Small (Number 1) Phillips screwdriver
- 4-mm socket wrench

Planning for Safety

Before planning any aspect of the Cisco CRS 4-slot LCC installation, review the following general safety guidelines. This list is not inclusive of all potentially hazardous situations, so be alert.

General Safety Guidelines

- Never attempt to lift an object that might be too heavy for you to lift by yourself.
- Always disconnect the power source and unplug all power cables before lifting, moving or working on the chassis.
- Keep the work area clear and dust free during and after installation.
- Keep tools and chassis components away from walk areas.
- Do not wear loose clothing, jewelry (including rings and chains), or other items that could get caught in the chassis.
- Fasten ties or scarfs and sleeves.
- Check that the Cisco CRS 4-slot LCC operates safely when it is used in accordance with its electrical ratings and product usage instructions.
- Do not work alone if potentially hazardous conditions exist.
- Always unplug the power cables when performing maintenance or working on the chassis, unless the replacement part is capable of online insertion and removal (OIR).
- Confirm that the installation of your chassis is in compliance with 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) 364, part 1 through part 7.
- Before installing, configuring, or maintaining the chassis, review the safety warnings listed in *Cisco CRS Carrier Routing System Regulatory Compliance and Safety Information,* which accompanied your chassis.
- Confirm that the AC powered Cisco CRS 4-slot LCC is shipped with a three-wire electrical grounding-type plug that fits only into a grounding-type power outlet. This is a safety feature. The equipment grounding should be in accordance with local and national electrical codes.

Compliance and Safety Information

The Cisco CRS 4-slot LCC is designed to meet regulatory, compliance, and safety approval requirements. If you require additional compliance information, see *Cisco CRS Carrier Routing System Regulatory Compliance and Safety Information* that is shipped with your chassis.

Preventing Electrostatic Discharge Damage

Electrostatic discharge (ESD) damage to chassis components can occur if the parts are handled improperly. Such mishandling can result in intermittent or complete failures of the equipment.

When handling any chassis components, observe the following guidelines to prevent ESD damage.

- Always use an ESD-preventive ankle or wrist strap and ensure that the strap makes adequate contact with your skin.
- The ankle or wrist strap protects equipment from ESD voltages on the body only; ESD voltages on clothing can still cause damage to electronic components.
- Use an ESD antistatic strap and follow its instructions for use.

Caution Periodically check the resistance value of the antistatic ankle or wrist strap. The resistance measurement should be between 1 and 10 megohms.

Laser Safety

Physical Layer Interface Modules (PLIMs) are equipped with lasers, which emit invisible radiation. Do not stare into open PLIM ports.

Danger Because invisible radiation may be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to radiation and do not stare into open apertures. Statement 127

Lifting Guidelines

A fully configured Cisco CRS 4-slot LCC weighs approximately 361 lb. (163.7 kg). Before installing the chassis, ensure that your site is properly prepared so you can avoid having to move the chassis later to accommodate power source and network connections.

Each time you lift any heavy assembly, refer to these lifting guidelines:

- Never attempt to lift an object that might be too heavy for you to lift by yourself
- Have a second person available to help lift the assembly
- Ensure that your footing is solid; balance the weight of the object between your feet
- Lift the assembly slowly; never move suddenly or twist your body as you lift
- To prevent injury to your back, keep your back straight while lifting the shelf and lift the equipment with your legs as you stand up
- If you must bend down to lift the assembly, bend at the knees, not at the waist, to reduce the strain on your lower back muscle
- Always disconnect the power source and unplug all power cables before lifting, moving or working on the chassis

Electrical Safety

The field replaceable units (FRUs) in the Cisco CRS 4-slot LCC offer online insertion and removal (OIR) capability, which means an FRU is hot swappable and can be removed and replaced while the system is operating without presenting an electrical hazard or damage to the system.

The following FRUs feature OIR:

- MSCs, FPs, and PLIMs
- RPs—Only when two are installed in the chassis
- SFCs
- Air filter

Note For more information on installing and removing components, see the Cisco CRS Carrier Routing System 4-Slot Line Card Chassis Installation Guide.

Working with electrical equipment can be hazardous. Three types of potential hazards are addressed in this section.

- Potential electrical accidents involving people and equipment
- Potential electrical accidents involving equipment only
- Potential electrical accidents involving your installation site

Electric Shock Hazard

Use these guidelines if an electrical accident occurs while working with any electrical equipment.

- Disconnect power to the system, never assume that power has been disconnected from a circuit; always check.

Danger Before assisting an injured person, make sure there is no possibility of electrical shock or other potential hazard to yourself.

- Send another person to get medical aid; otherwise, assess the condition of the victim and then call for help.
- Determine if the person needs rescue breathing or external cardiac compressions, then take appropriate action.

Equipment Hazards

Use these guidelines when working with equipment you want to install:

- Disconnect all power and external cables before installing or removing a chassis.

- Never assume that power has been disconnected from a circuit; always check.
- Do not perform any action that creates a potential hazard to people or makes the equipment unsafe.
- Never install equipment that appears damaged.
- Carefully examine your work area for possible hazards such as:
  - Moist floors
  - Ungrounded power extension cables
  - Missing safety grounds

Installation Hazards

Use these guidelines when working with equipment that is disconnected from a power source, but is still connected to telephone or network wiring.

- Never install telephone wiring during a lightning storm.
- Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations.
- Never touch uninsulated telephone wires or terminals unless you are sure the telephone line has been disconnected at the network interface.
- Use caution when installing or modifying telephone lines.

Planning for Space

Space planning for the Cisco CRS 4-slot LCC is consistent with other chassis that install in a standard 19-inch (48-cm) Telco equipment rack. This section includes the following topics:

Rack-Mounting Planning Guidelines

Before installing the Cisco CRS 4-slot LCC in a rack, consider the following general rack-mounting guidelines.

- As you face the rear of the chassis, the fan tray assembly is located on the top portion of the chassis. Air flow to the air inlet on the front of the chassis and the rear fan tray assembly should not be blocked.

Note Warm air exhausts at the back of the chassis through the fan tray. Allow sufficient air flow by maintaining a minimum of 6 inches (15 cm) of clearance at the front and rear of the chassis.

- A ventilation system that is too powerful in an enclosed rack can also prevent cooling by creating negative air pressure around the chassis and redirecting the air away from the air intake vent. If necessary, operate the chassis with the rack door open or in an open rack.
- The correct use of baffles inside an enclosed rack can assist in cooling the chassis.
- Equipment located near the bottom of the rack can generate excessive heat that is drawn upward and into the intake ports of equipment above, leading to possible overheat conditions.

Note The rack-mounting hardware included with the Cisco CRS 4-slot LCC is suitable for most 19-inch (48-cm) equipment racks.

- For the CRS-4-LCC to meet GR-63-CORE Zone 4 Earthquake Requirements, a 19" rack designed to withstand GR-63-CORE Zone 4 earthquakes for the intended rack weight loading must be used.
- Be sure that the rack is bolted to the floor. The chassis mounts to the two rack posts, and the rest of the chassis is cantilevered off of the posts.
- Ensure that the weight of the chassis does not make the rack unstable.
- Some racks are secured to ceiling brackets, if necessary, because of the weight of the equipment in the rack. Make sure that the rack you are installing the chassis in is secured.
- If mounting the chassis on a four-post rack, it must be recessed no more than 1.5 inches (3 cm) for the front door to fully open and close and to provide adequate room for cable routing.

Multiple Chassis in a Rack

One of the unique features of the Cisco CRS 4-slot LCC is its size. Up to two chassis can fit in a standard 19-inch (48-cm) equipment rack. When placing multiple chassis in a rack, ensure there is sufficient ventilation to accommodate both chassis.

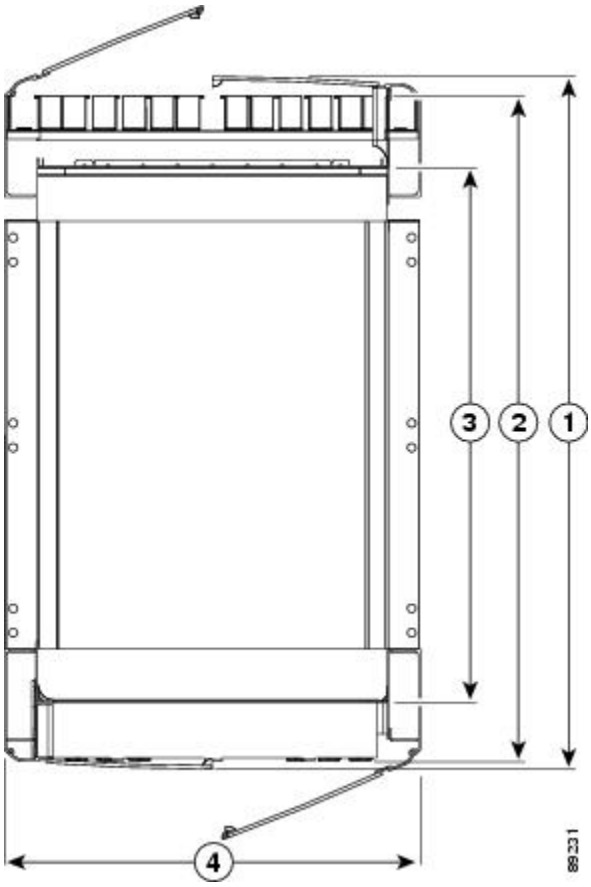
Hot exhaust air from other equipment can enter the inlet air vents and cause an overtemperature condition inside the chassis.

- Install and use the line card brackets and the chassis cable-management bracket included with the chassis to keep cables organized and out of the way of PLIMs.
- Ensure that cables from other equipment do not interfere with access to the card cage, or require you to disconnect cables unnecessarily to perform equipment maintenance or upgrades.
- When mounting the chassis in a four-post type rack, be sure to use all of the screws provided to secure the chassis to the rack posts.

Cisco CRS 4-Slot Line Card Chassis Footprint

The figure below shows a top view of the Cisco CRS 4-slot LCC footprint. The front of the chassis is at the top of the figure.

Figure 4: Top View of the 4-Slot Line Card Chassis



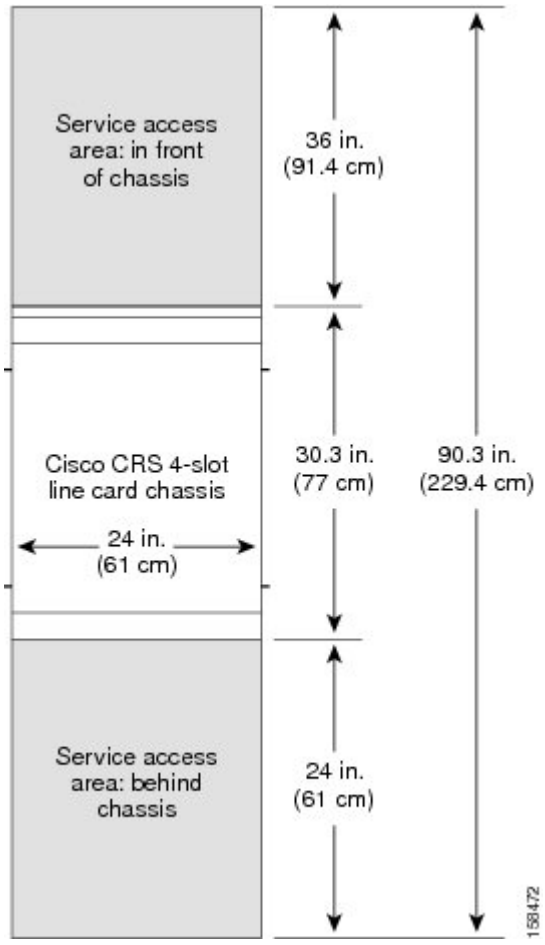
1	Depth (without cosmetic doors) 30.2 in. (76.9 cm)	2	Width 18.5 in. (47.1 cm)

Aisle Spacing and Maintenance Access Floor Plan

Make sure that enough space exists at the installation site to install the line card chassis 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 supplies, cables, and the air filter). The figure below shows a typical floor plan and the table below lists the minimum clearances required.

Figure 5: Line Card Chassis Floor Plan



The table below lists the minimum installation and maintenance access clearances required for the chassis.

Table 6: Cisco CRS 4-Slot Line Card Chassis Clearance Requirements

Type of Access	Clearance Required	Purpose
Chassis Clearance		
Front	36 in. (91.4 cm)	To allow access to chassis components (for example, to access cables).
Rear	24 in. (61 cm)	To allow access to chassis components (for example, to remove fan trays, power supplies, and air filters).

Type of Access	Clearance Required	Purpose
Inlet and exhaust openings (chassis and power supplies)	6 in. (15.2 cm)	To allow sufficient airflow for chassis components.
Side of chassis (left and right)	None	
Aisle Clearance		
Aisle width	50 in. (127 cm)	To move the chassis through an aisle.
	Note The preceding aisle width does not include space on either side of the chassis for the hands of the mover.	
Turn radius of chassis	50 inches (127 cm)	To turn the chassis.

Note The most up-to-date clearance requirement information is located in the Cisco CRS Carrier Routing System 4-Slot Line Card Chassis Unpacking, Moving, and Securing Guide.

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.

Planning for Power

The chassis power system provides power to chassis components and is made up an AC or DC power shelf that contains four power supplies. Each power supply is connected to a separate and independent power source.

Each power supply receives input power from a different power source. The power system provides 1+1 redundancy. During normal operation, the power shelf and power supplies function together to power the chassis. However, if a power source to one or two power supplies fails, the remaining power supplies provide enough input power to power the chassis. This 1+1 redundancy enables the chassis to operate despite a limited power failure or during power supply replacement.

The Cisco CRS 4-slot LCC features a single power shelf consisting of four 2000-W AC or DC power supplies. Site requirements differ depending on the type of power source voltage.

This section includes the following topics:

Note For additional power system details, see the Cisco CRS Carrier Routing System 4-Slot Line Card Chassis Installation Guide.

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 AC Power System, on page 23 and the DC Power System, on page 24 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, you may want to consult a facilities electrical expert to understand the load that the routing system may put on the facility power plant.

- Installation of the Cisco CRS 4-slot LCC 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
- Four separate and independent AC or DC power sources are needed to provide 1+1 redundancy for system power. Each pair of power supplies has its own circuit breaker.
- Each power source must provide clean power to the site. If necessary, install a power conditioner.
- Sites 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:
- For AC-powered systems, a grounding-type AC power outlet is required.
- For DC-powered systems, the installation must have a ground connection of the appropriate gauge to the DC power shelf ground lug.
- When planning power for the site, be sure to 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 *Cisco CRS Carrier Routing System Regulatory Compliance and Safety Information.*

Site Wiring

This section offers site wiring guidelines for setting up the plant wiring and cabling at your site. When planning the location of the new system, consider the following:

- Electromagnetic interference (EMI)
- Distance limitations for signaling and unshielded conductors

Electromagnetic Interference

Electromagnetic interference can occur between the signal on the wires and external or ambient EMI fields when the wires are run for any significant distance. Bad wiring practice can result in radio interference emanating from the plant wiring.

Note To predict and remedy strong EMI, you may need to consult experts in radio frequency interference (RFI).

If you use twisted-pair cable in your plant wiring with a good distribution of grounding conductors, the plant wiring is unlikely to emit radio interference. If you exceed the recommended distances, use a high-quality twisted-pair cable with one ground conductor for each data signal when applicable.

Electromagnetic Pulse Considerations

Give special consideration to the effect of a lightning strike in your vicinity if wires exceed recommended distances, or if wires pass between buildings. The electromagnetic pulse (EMP) caused by lightning or other high-energy phenomena can easily couple enough energy into unshielded conductors to destroy electronic devices.

Provide a properly grounded and shielded environment, with special attention to issues of electrical surge suppression, to avoid the time loss to identify and resolve future surge and distance issues after your chassis is installed.

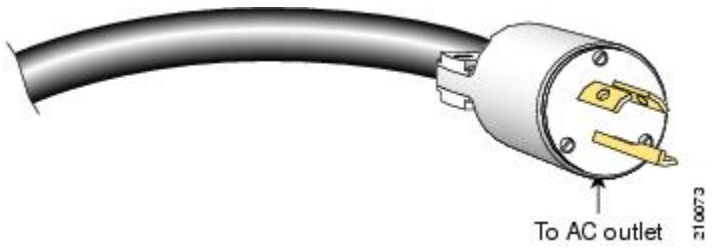
AC Power System

Each AC-powered line card chassis requires 4270 watts (4.27 kW) of AC input power. Two of the four 2000-watt power supplies must be functioning in order to properly power the chassis. The power supplies are 92percent efficient.

Each AC-powered chassis includes a single power shelf consisting of four power supplies. This “two and two” configuration within the single power shelf provides 1+1 redundancy. Each power supply requires one input power connection. The power shelf supports four AC-to-DC power supplies that are FRUs. The AC-to-DC power supplies convert 200 to 240 VAC power to –54 VDC used by the Cisco CRS 4-slot LCC.

The power cables, which are 13 feet (4 m) long, are not shipped preattached to the power shelf. The figure below shows the AC power cord plug. AC power input is 2 wires + protective earthing. The gauge of the earth conductor must be equal to or larger than that of the phase conductor.

Figure 6: AC Power Cord Plug



For additional power system details, see the Cisco CRS Carrier Routing System Line Card Chassis Installation Guide.

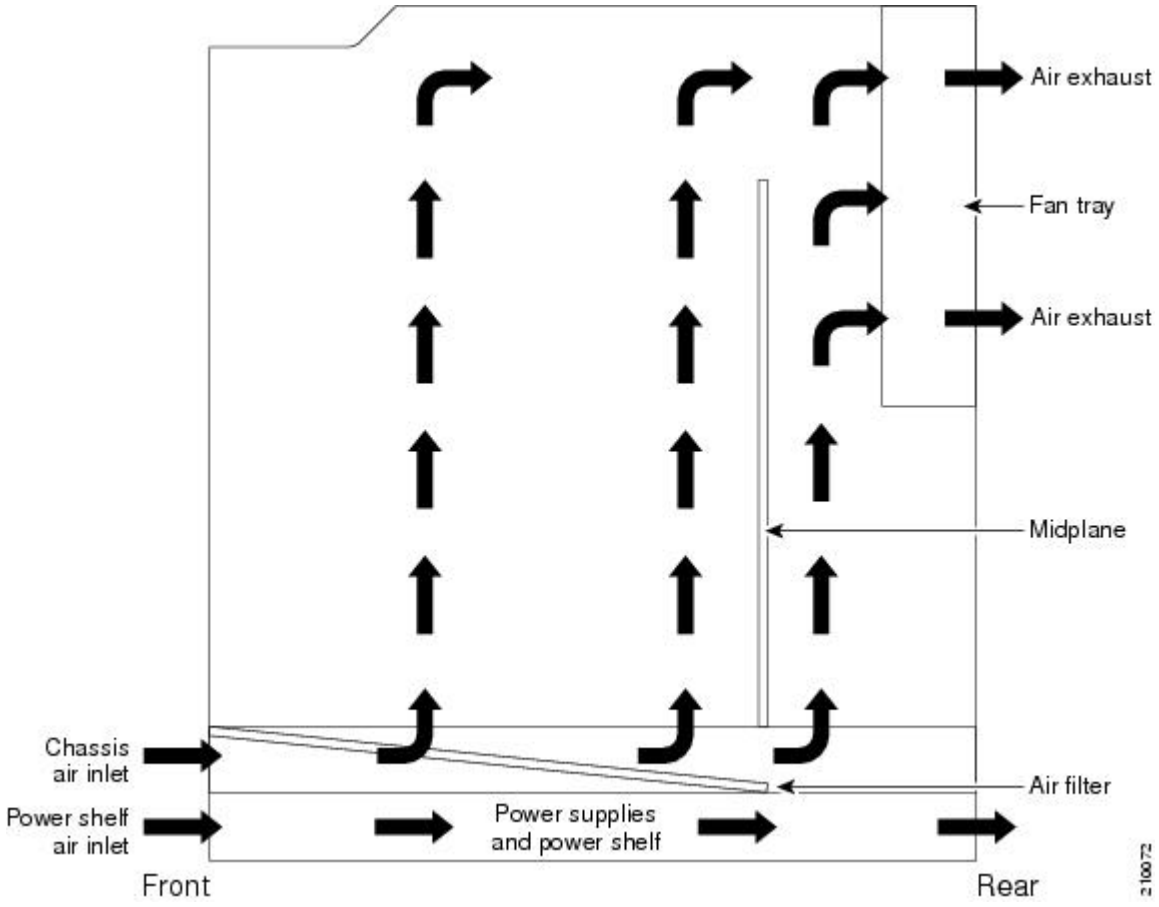
DC Power System

The Cisco CRS 4-slot LCC DC power shelf consists of two major components (see the figure below):

- DC power input shelf (Cisco product number: CRS-4-DC-INPUT)
- Power input module (PIM) (Cisco product number: CRS-4-DC-PIM)

When installing the DC power shelf, these two components are mated to create the complete DC power shelf. The figure below shows the PIM and the DC power input shelf.

Figure 7: DC Power Shelf: DC Power Input Shelf and Power Input Module (PIM)



1	DC power input shelf	2	Power input module (PIM)

The Cisco CRS 4-slot LCC DC power system provides 4,000 watts to power the chassis. (To provide power redundancy, up to 8,000 watts are available.) Each DC-powered chassis contains four DC power supplies for 2N redundancy. The PIM provides the input power connections. Note that each power connection has two cables: –48 VDC and return. The PIM, DC power input shelf, and the power supplies are field replaceable.

The Cisco CRS 4-slot LCC requires a total of four dedicated pairs of 60-A DC input power connections, one pair for each of the power supplies, to provide redundant DC power to the Cisco CRS 4-slot LCC midplane.

For full 2N redundancy, we recommend that you have two independent –48 VDC power sources to provide power to the Cisco CRS 4-slot LCC. Connect the two 60-A DC inputs on the left to one wiring block, and the two 60-A DC inputs on the right to the other wiring block.

For more information, see Chapter 2, "Installing and Removing Power Components," in the *Cisco CRS Carrier Routing System Line Card Chassis Installation Guide* .

Planning for Cooling

Proper air circulation and cooling are essential to ensure optimal Cisco CRS 4-slot LCC operation. This section includes information on how to plan for the environment that the chassis will be operated in. This section includes the following topics:

Environmental Guidelines

This section offers guidelines for operating your Cisco CRS 4-slot LCC in various environments. Included are airflow, temperature, and humidity recommendations. To assure normal operation and avoid maintenance difficulty, plan and prepare your site before you install the chassis.

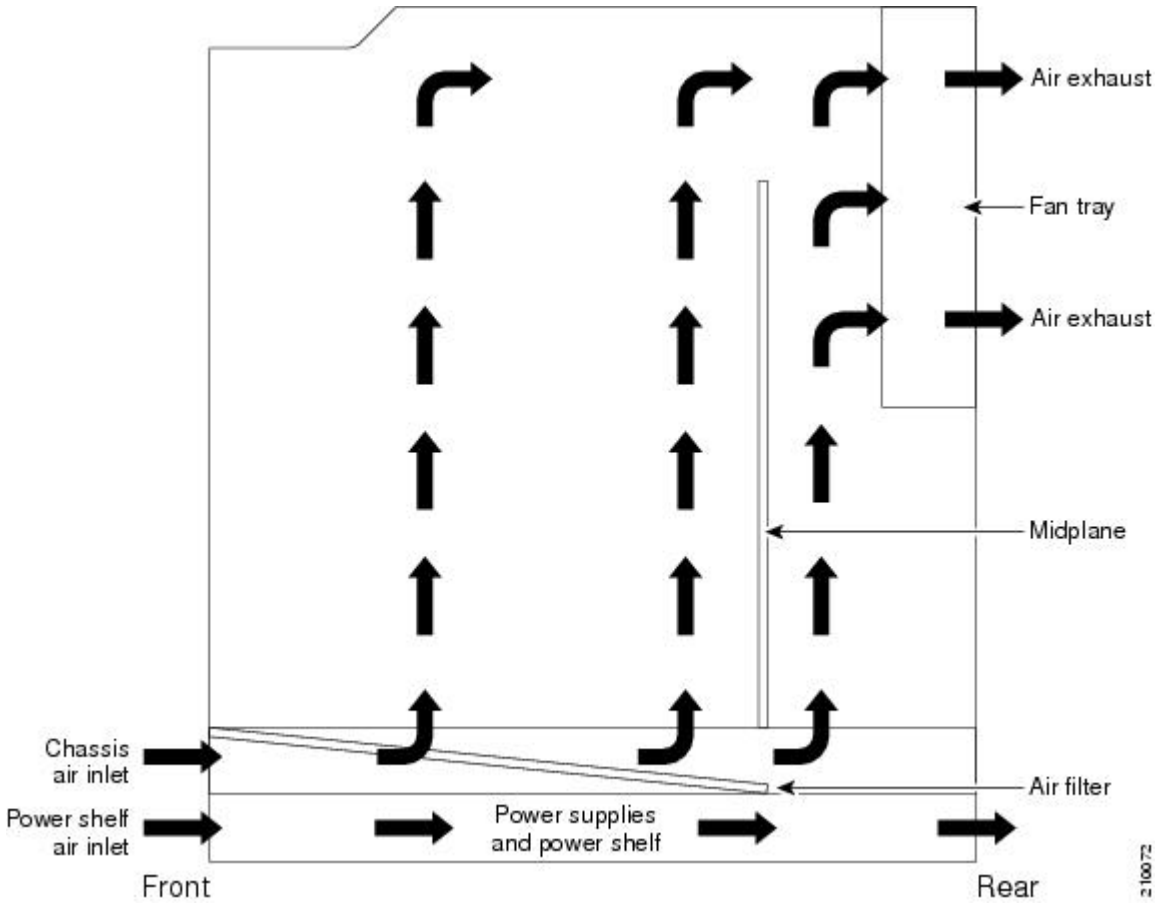
Airflow

The airflow through the Cisco CRS 4-slot LCC is controlled by a push-pull configuration. The figure below shows how ambient air flows in at the bottom front of the Cisco CRS 4-slot LCC and up through the card cages until it exhausts at the top rear. The power supplies in the power shelves have their own self-contained cooling fans. The Cisco CRS 4-slot LCC has a maximum airflow of 880 cubic feet (24,918 liters) per minute.

A replaceable air filter is positioned above the power shelf. 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 then check the air filter to see if it needs replacement.

Caution Do not remove the air filter with the fan tray functioning. See the Cisco CRS Carrier Routing System 4-Slot Line Card Chassis Installation Guide for specific instructions on how to service the air filter.

Figure 8: Airflow Through 4-Slot Line Card Chassis



As shown in the above figure, air circulates through the card cage, and exhausts at the back of the chassis

- Allow sufficient air flow by maintaining 6 inches (15 cm) of clearance at both the front inlet and rear exhaust openings on the chassis.
- Sites should be as dust-free as possible. Dusty environments can clog the air filter, reducing the cooling airflow through the chassis. This can cause an over temperature condition in the chassis.

Under extreme environment conditions, the environmental monitoring system shuts down the power to protect the system components.

Temperature and Humidity

The operating environmental site requirements are listed in *Cisco CRS 4-Slot Line Card Chassis System Specifications* of the *Cisco CRS Carrier Routing System 4-Slot Line Card Chassis Site Planning Guide* The

temperature and humidity ranges listed are those within which the chassis continues to operate. You can maintain normal operation by anticipating and correcting environmental irregularities before they approach critical values.

The environmental monitoring functionality built into the chassis protects the system and components from potential damage from overvoltage and overtemperature conditions.

Planning for Cabling

Cabling runs should be carefully planned. The basic configurations for various routing systems should be arranged to minimize the complexity and length of the cable runs. Precut and terminated cables are considered part of the basic configuration. This section includes the following topics:

Physical Layer Interface Module Cables

You must provide the MSC and PLIM interface cables. You also provide the cable management trays for these cables from the Cisco CRS 4-slot LCC to your facility interconnect. Interfaces vary with each system site, plan these data cable runs in advance of the system installation.

Chassis Cable-Management

The Cisco CRS 4-slot LCC has cable-management features for the front of the chassis. These cable-management features consist of horizontal cable-management trays above the card cage. These 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 in installing the cables in the chassis.

For detailed information about chassis cabling and cable management, see the Cisco CRS Carrier Routing System 4-Slot Line Card Chassis Installation Guide.

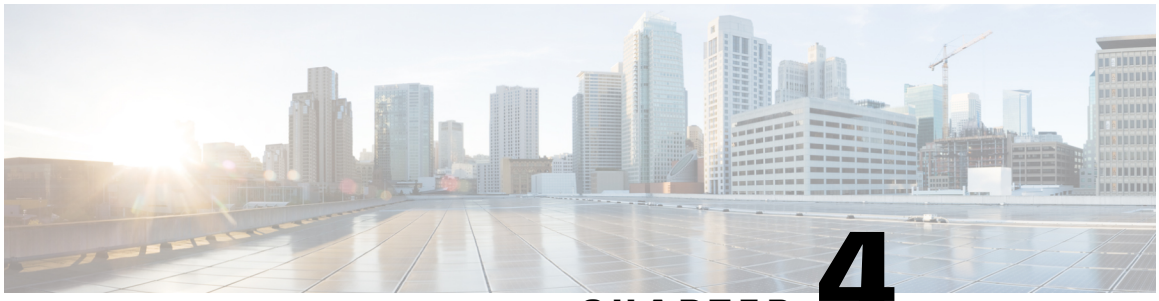
Planning for High Availability

The following is a list of tasks you can consider doing to configure the line card chassis for high availability, which helps to ensure that service is not disrupted due to failures:

- Consider installing a redundant line card chassis, whose user interface links mirror the links on the other line card chassis. This way, if something happens to one line card chassis, the links are still operational on the other line card chassis.

To provide more high availability, you can also install each line card chassis 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.

- Consider running the power cables from the power shelf along different routes through the facility or at the installation site.
- Consider running PLIM user interface cables along different routes.



CHAPTER 4

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 table below shows a sample preliminary site survey form.

Table 7: 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:	

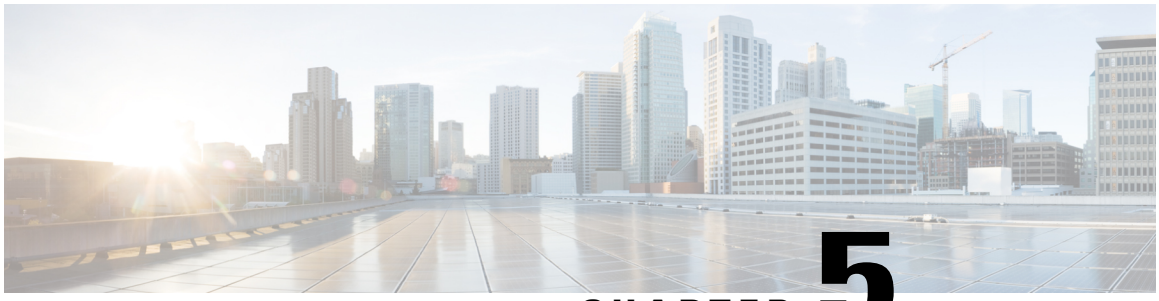
Preliminary Site Survey	
Special instructions:	
Hours and days of operation:	
Site Survey Contacts	
Primary Contact	
Name:	
Title:	
Phone number:	
Mobile phone number:	
Fax number:	
Pager number:	
E-mail address:	
Secondary Contact	
Name:	
Title:	
Phone number:	
Mobile phone number:	
Fax number:	
Pager number:	
E-mail address:	
Delivery and Installation Constraints	
Is there a loading dock available to unload the equipment at this site?	

Preliminary Site Survey		
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?		
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.		
Floor Mounting		
How many line card chassis will be installed? Is there floor space available for all of the chassis?		
Make a sketch of the area where the chassis is to be installed and note the chassis location.		
Power		
Is AC 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.		

Preliminary Site Survey	
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.	
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.	
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.	
Supported Data Interfaces	
Will the routing system be connected to OC-3/STM-1 POS circuits? How many ports?	

Preliminary Site Survey		
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), 10-GE, or 100-GE circuits? How many ports?		
Cable Plant		
Have the cables been pulled for all data interfaces? If not, list the outstanding cabling that needs to be installed and the scheduled completion dates.		
Are there connection points on the fiber distribution panel for all optical cables connecting to the routing system?		
Will fiber jumpers be provided? What length of fiber jumper is required to complete the installation?		
What type of fiber connector is used at the site?		
If attenuation is required, will attenuators be provided? If not, who will pay for the attenuators?		

Preliminary Site Survey



CHAPTER 5

System Specifications

Cisco CRS 4-Slot Line Card Chassis System Specifications

This appendix provides the specifications for the Cisco CRS Carrier Routing System 4-Slot Line Card Chassis. It contains the following sections:

Cisco CRS 4-Slot Line Card Chassis Specifications

The table below lists Cisco CRS 4-slot line card chassis specifications.

Table 8: Cisco CRS 4-Slot Line Card Chassis Specifications

Description	Value
Physical Dimensions	
Height	30 in. (76.2 cm)
Depth	30.28 in. (76.9 cm)(including front doors)
Width	17.65 in. (44.8 cm)
Weight	
Chassis with fan tray, power shelf, and impedance carriers installed (as shipped)	260 lb (117.9 kg), chassis only338 lb (153.3 kg), chassis including packaging and pallet
Chassis with all components installed (without exterior cosmetic components and packaging)	361 lb (163.7 kg)

Description	Value
Cards and Modules Supported	4 modular services cards (MSCs) or forwarding processor (FP) cards (line cards) 4 physical layer interface modules (PLIMs) or 4 shared port adapter (SPA) interface processors (SIPs), each of which supports one or more SPAs 2 route processor (RP) cards or 2 performance route processor (PRP) cards 4 switch fabric cards (SFCs) 1 fan tray
Power Shelves	
AC power shelf	Supports four AC-to-DC rectifiers
DC power shelf	Supports four DC power supplies
Maximum Power Consumption	Total input power
Maximum AC input power	4185 W (assuming 92% efficiency)
Maximum DC input power	4278 W (assuming 90% efficiency)
Power Redundancy	
AC	1:1—Requires two independent AC sources
DC	We recommend two independent –48 VDC power sources
AC Input Power	2W+PE (2 wire + protective earthing[1])
Nominal input voltage	200 to 240 VAC(range: 180 to 264 VAC)
Nominal line frequency	50 or 60 Hz(range: 47 to 63 Hz)
Recommended AC service	20 A (per AC rectifier)
DC Input Power	
Nominal input voltage	Supports –48 VDC and –60 VDC systems (range: –40 to –72 VDC)
Input line current	50-A maximum at –48 VDC40-A maximum at –60 VDC

Description	Value
Inrush current	60-A peak at –75 VDC(maximum for 1 ms)
Chassis Cooling	1 fan tray, pull configuration
Chassis airflow	Up to 880 cubic ft (24,919 liters) per minute
Power shelf airflow	60 cubic ft (1699 liters) per minute

1 Protective earthing conductor (ground wire).

Environmental Specifications

The below table lists the environmental specifications for the Cisco CRS 4-slot line card chassis.

Table 9: Cisco CRS 4-Slot 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)[2] Nonoperating: –40° to 158°F (–40° to 70°C)
Humidity	Operating: 5% to 85% noncondensing Nonoperating: 5% to 90% noncondensing, short-term operation
Altitude	–197 to 5906 ft (–60 to 1800 m) at 122°F (50°C), short-term Up to 10,000 ft (3048 m) at 104°F (40°C) or below
Heat dissipation	AC: 14,280 BTU per hour (maximum) DC: 14,597 BTU per hour (maximum)
Power density	12,406 W per square meter (maximum)
Average air exhaust temperature	129°F (54°C)—At room temperatures of 95 to 102°F (35 to 39°C) 149°F (65°C)—Maximum exhaust temperature on a fully loaded system during worst-case operating conditions (50°C and 6000 ft altitude)

Description	Value
Acoustic noise	Fans at normal to moderate speed: 67 dBa—front of chassis77 dBa—rear of chassis Fans at maximum speed (7500 RPM): 83 dBa—front of chassis93 dBa—rear of chassis
Shock and vibration	Designed and tested to meet the NEBS shock and vibration standards defined in GR-63-CORE (Issue 2, April 2002).

[2] "Short-term" refers to a period of not more than 96 consecutive hours and a total of not more than 15 days in one year. This refers to a total of 360 hours in any given year, but no more than 15 occurrences during that one-year period.

Compliance and Safety Specifications

For information about the compliance and safety standards with which the Cisco CRS carrier routing system conforms, see Regulatory Compliance and Safety Information for the Cisco CRS Carrier Routing System.

Note Statement 273, Blower Handle Warning, is applicable only to the Cisco CRS 4-slot line card chassis.