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Cisco ASR 9000 Series Aggregation Services Routers Overview and Reference Guide

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You can determine whether your equipment is causing interference by turning it off. If the interference stops, it was probably caused by the Cisco equipment or one of its peripheral devices. If the equipment causes interference to radio or television reception, try to correct the interference by using one or more of the following measures:

• Turn the television or radio antenna until the interference stops.

• Move the equipment to one side or the other of the television or radio.

• Move the equipment farther away from the television or radio.

• Plug the equipment into an outlet that is on a different circuit from the television or radio. (That is, make certain the equipment and the television or radio are on circuits controlled by different circuit breakers or fuses.)

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Preface

The Cisco ASR 9000 Series Aggregation Services Routers Overview and Reference Guide preface contains the following sections:

Changes to This Document

Revision	Date	Change Summary
OL-17501-01	March 2009	Initial release of this document.

Audience

This *Cisco ASR 9000 Series Aggregation Services Routers Overview and Reference Guide* is written for hardware installers and system administrators of Cisco routers.

This publication assumes that the user has a substantial background in installing and configuring router and switch-based hardware. The reader should also be familiar with electronic circuitry and wiring practices, and have experience as an electronic or electromechanical technician.

Purpose

This guide provides an overview of the basic hardware configuration and features of the Cisco ASR 9000 Series Aggregation Services Routers.

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Document Organization

This document is organized into the following chapters and appendixes:

- Chapter 1, "Overview and Physical Description," provides an introduction to the major components of the ASR 9000 Series Routers.
- Chapter 2, "Functional Description," describes in more detail the major components of the ASR 9000 Series Routers and provides functional descriptions of basic hardware features and operations.
- Appendix A, "Technical Specifications," provides a summary of physical, electrical, and environmental specifications for the router.

Document Conventions

This publication uses the following conventions:

- **Ctrl** represents the key labeled "Ctrl". For example, the key combination **Ctrl-Z** means hold down the **Ctrl** key while you press the **z** key.

Command descriptions use these conventions:

- Examples that contain system prompts denote interactive sessions, indicating the commands that you should enter at the prompt. The system prompt indicates the current level of the EXEC command interpreter.

  For example:

  - The `router>` prompt indicates that you should be at the *user* level.
  - The `router#` prompt indicates that you should be at the *privileged* level.

    Access to the privileged level usually requires a password. Refer to the related software configuration and reference documentation for additional information.

- Commands and keywords are in **bold** font.
- Arguments for which you supply values are in *italic* font.
- Elements in square brackets ([ ]) are optional.
- Alternative but required keywords are grouped in braces ({ }) and separated by vertical bars (|).

Caution Means *be careful*. You are capable of doing something that might result in equipment damage or loss of data.

Note Means *take note*. Notes contain helpful suggestions or references to materials not contained in this manual.

Timesaver Means *the described action saves time*. You can save time by performing the action described in the paragraph.

Warning **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. To see translations of the warnings that appear in this publication, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Obtaining Documentation and Submitting a Service Request

For information on obtaining documentation, submitting a service request, and gathering additional information, see the monthly *What's New in Cisco Product Documentation*, which also lists all new and revised Cisco technical documentation, at:

http://www.cisco.com/en/US/docs/general/whatsnew/whatsnew.html

Subscribe to the *What's New in Cisco Product Documentation* as a Really Simple Syndication (RSS) feed and set content to be delivered directly to your desktop using a reader application. The RSS feeds are a free service and Cisco currently supports RSS Version 2.0.

CHAPTER 1

Overview and Physical Description

This chapter includes the following sections:

Related Documentation

For additional information about the Cisco ASR 9000 Series Aggregation Services Routers, please refer to the following documents:

- *Cisco ASR 9000 Series Aggregation Services Routers Installation Guide*
- *Cisco ASR 9000 Series Aggregation Services Routers Ethernet Line Cards Installation Guide*
- *Cisco ASR 9000 Series Aggregation Services Routers Getting Started Guide*

Product Overview

The Cisco ASR 9000 Series Routers are next-generation Edge Access Routers optimized for Service Provider applications, designed to fulfill a variety of roles in:

- Layer 2 and Layer 3 Ethernet aggregation
- Subscriber-aware broadband aggregation

The Cisco ASR 9000 Series Routers meet carrier-class requirements for redundancy, availability, packaging, power, and other requirements traditional to the Service Provider.

The Cisco ASR 9000 Series is comprised of two routers, the Cisco ASR 9010 Router and the Cisco ASR 9006 Router.

Figure 1-1 shows a fully-configured Cisco ASR 9010 Router with redundant RSPs and power modules, and eight line cards installed.

Figure 1-1 Cisco ASR 9010 Aggregation Services Router

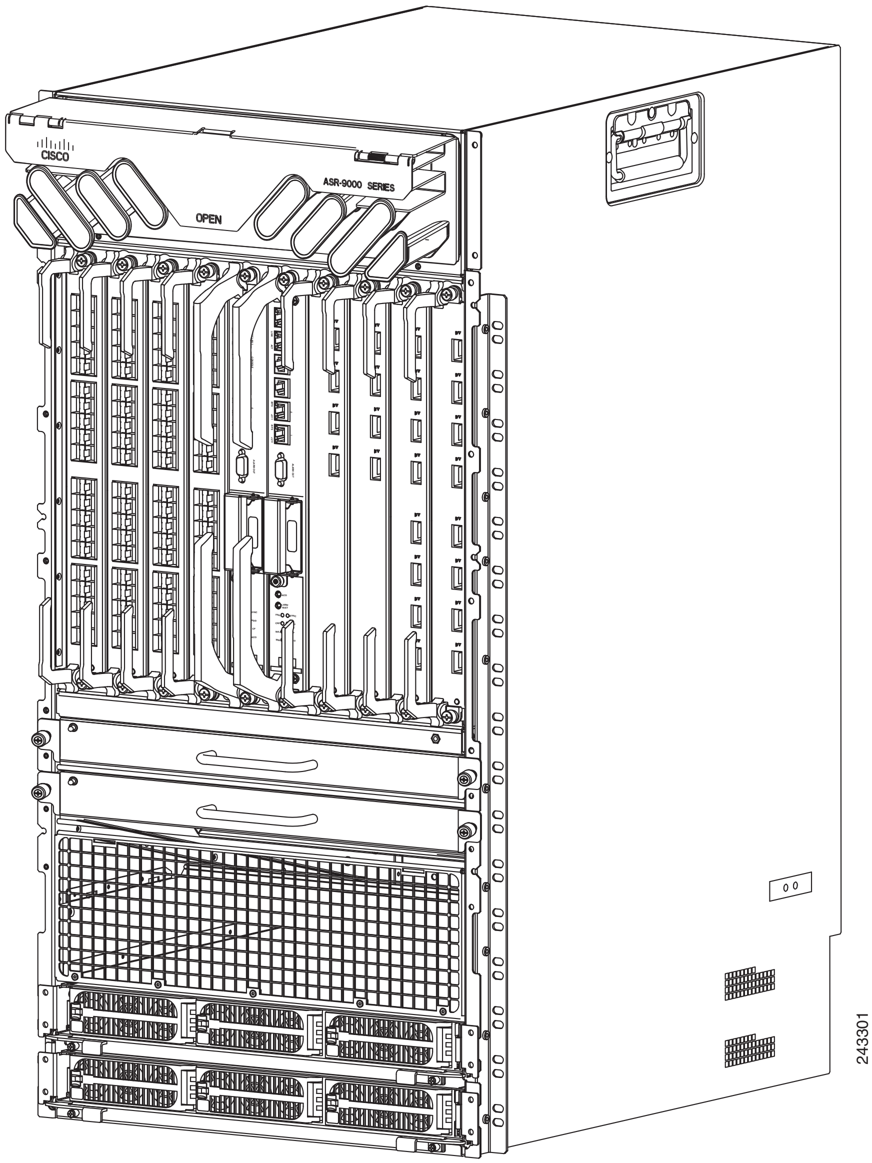

Figure 1-2 shows a fully-configured Cisco ASR 9006 Router with redundant RSPs and power modules, and four line cards installed.

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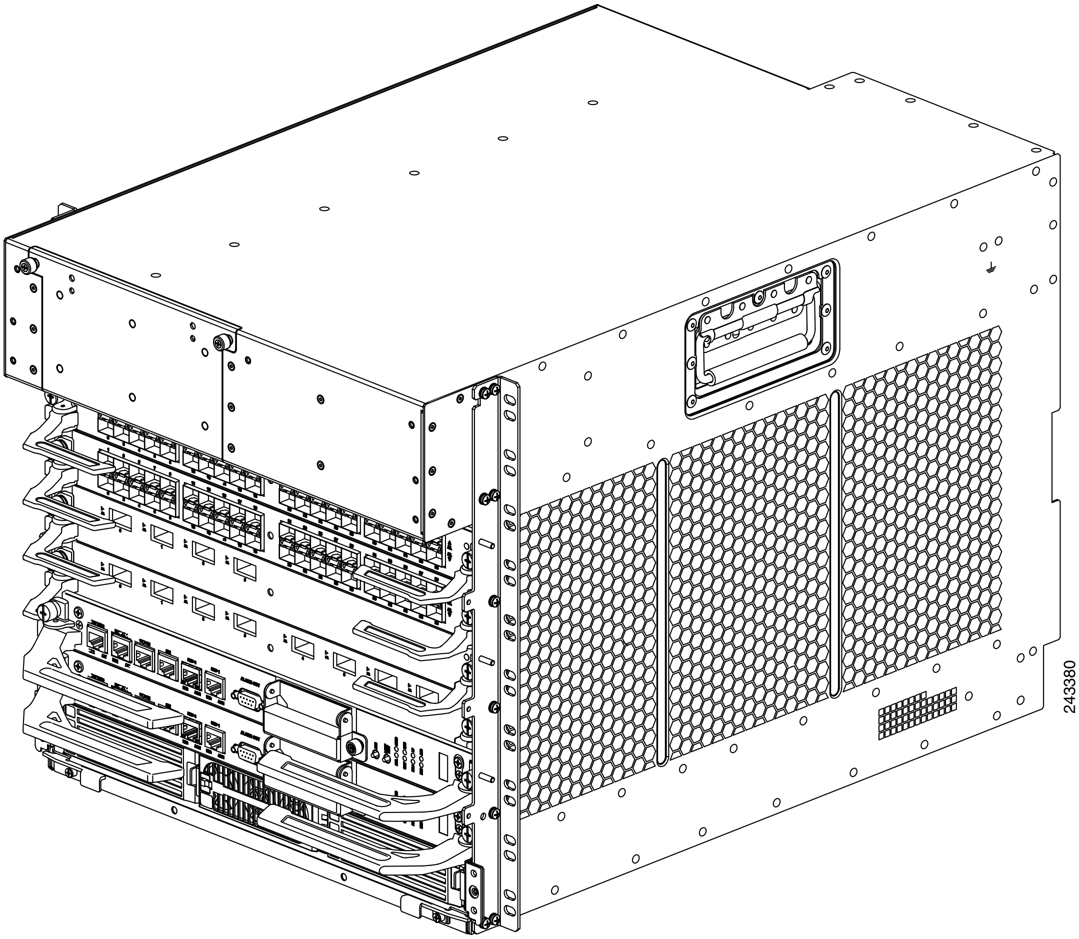
Figure 1-2 Cisco ASR 9006 Aggregation Services Router



Chassis Physical Overview

ASR 9010 Series Router

The Cisco ASR 9010 Router chassis is centered around a redundant pair of Route Switch Processor (RSP) cards, along with eight Ethernet line cards. The 10-slot chassis size fits in Telco, EIA, and ETSI racks and cabinets. Figure 1-3 identifies all slots locations in the Cisco ASR 9010 Router chassis.

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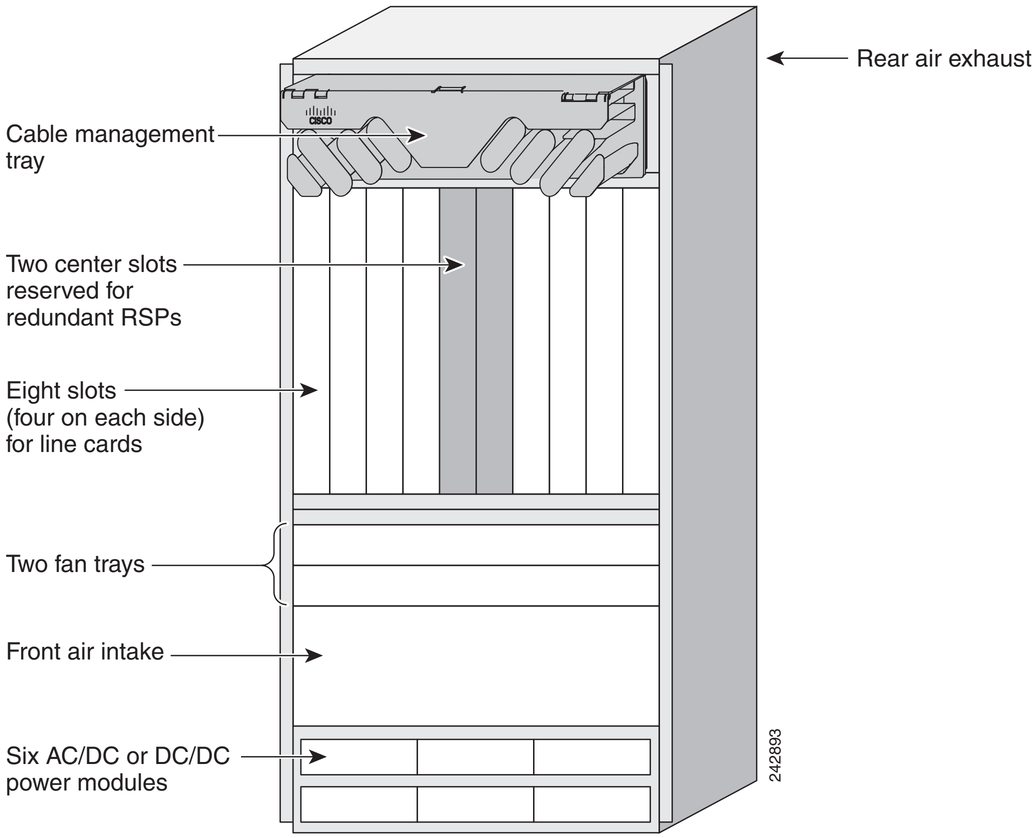
Figure 1-3 ASR 9010 Major Chassis Components



ASR 9006 Series Router

The Cisco ASR 9006 Router chassis is centered around a redundant pair of Route Switch Processor (RSP) cards, along with four Ethernet line cards. The 6-slot chassis size fits in Telco, EIA, and ETSI racks and cabinets. Figure 1-3 identifies all slots locations in the Cisco ASR 9006 Router chassis.

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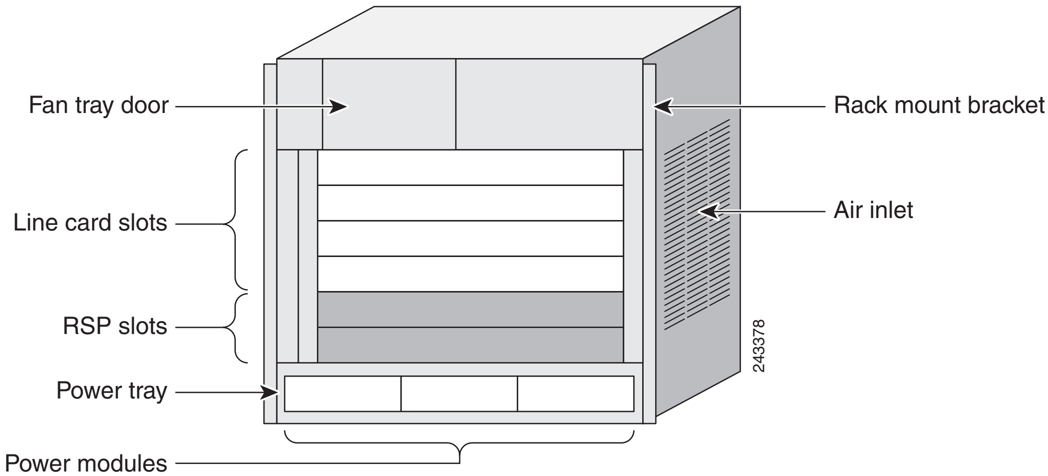
Figure 1-4 ASR 9006 Major Chassis Components



Rack-Mounting Considerations

The chassis width of both Cisco ASR 9000 Series Routers fits into the following racks:

- Telco racks with a rail-to-rail dimension of 17.50 inches (44.54 cm) for the Cisco ASR 9010 Router or 17.75 inches (45.09 cm) for the Cisco ASR 9006 Router.
- EIA racks 19 inches (48.26 cm) wide
- Adaptable to 23 inches (58.42 cm) to fit into ETSI racks 23.62 inches (60.00 cm) wide

The Cisco ASR 9010 Router chassis height is 36.75 inches (93.35 cm) or 21 RU (rack units) which includes a rack/shelf mounting option. Two chassis fits into a commonly used 42RU rack, and therefore will fit into an ETSI 45RU rack with a height of 78.74 inches (200.00 cm).

The Cisco ASR 9006 Router chassis height is 17.50 inches (44.45 cm) or 10 RU (rack units) which includes a rack/shelf mounting option. Four chassis fits into a commonly used 42RU rack, and therefore will fit into an ETSI 45RU rack with a height of 78.74 inches (200.00 cm).

The chassis depth for both Cisco ASR 9000 Series Routers fits into a 31.50 inch (80.00 cm) deep EIA rack or an equivalent 80.00 cm deep ETSI rack. This space includes cable management space front and rear. The chassis has fixed rack mount rails that are set back 5.00 inches (12.7 cm), including front cable management space.

Note Racks and cabinets will require adjustable front rails if the rack/cabinet doors must be able to close with the chassis installed.

Figure 1-5 shows the top-down view dimensions of the Cisco ASR 9010 Router.

Figure 1-6 shows the top-down view dimensions of the Cisco ASR 9006 Router.

Figure 1-5 Cisco ASR 9010 Router Chassis Dimensions (Top-down View)

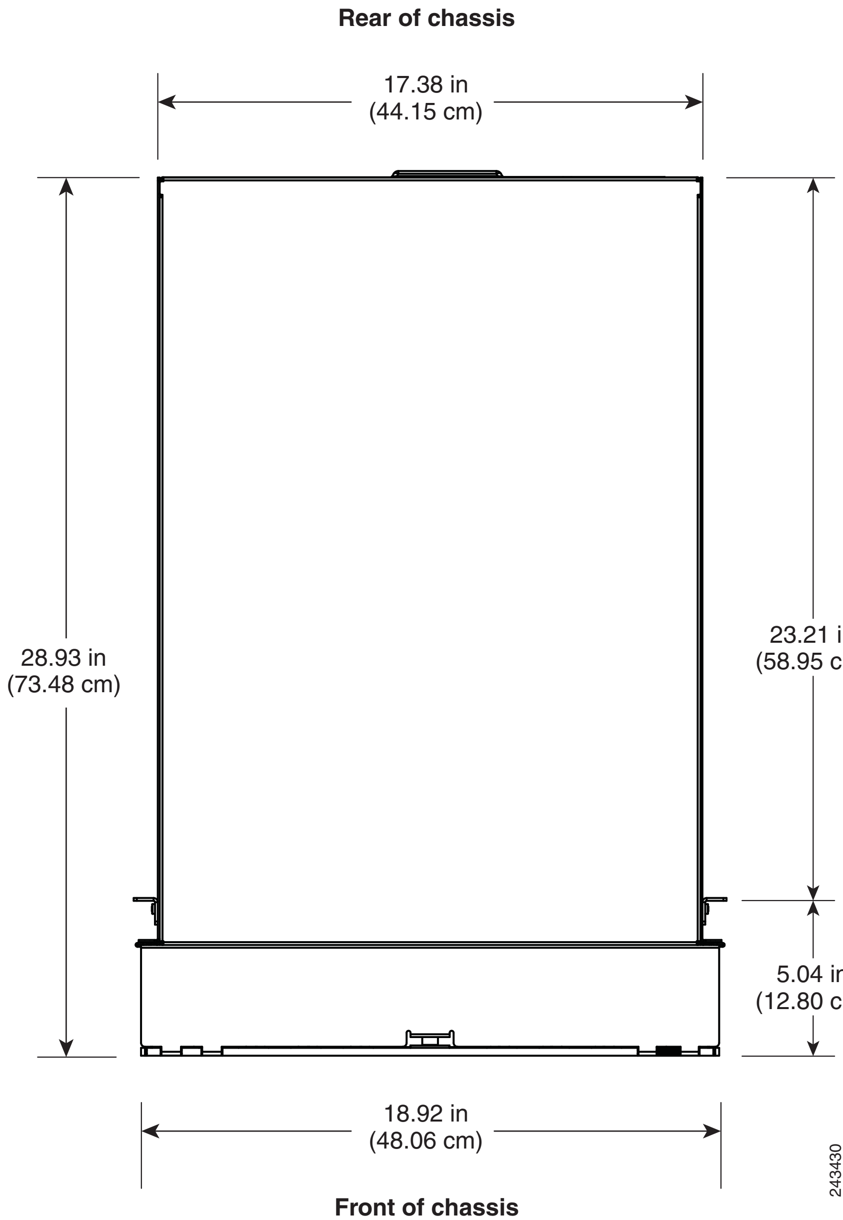
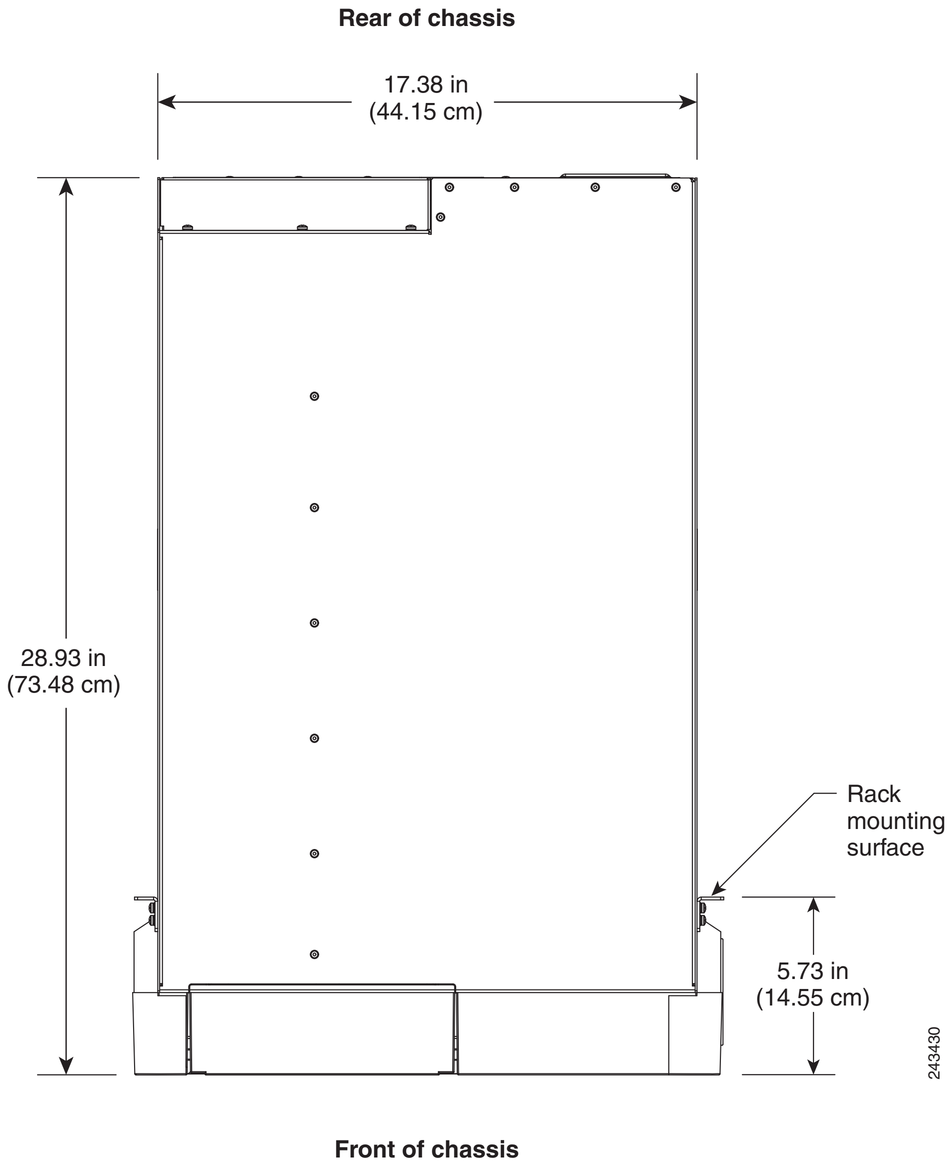


Figure 1-6 Cisco ASR 9006 Router Chassis Dimensions (Top-down View)



Chassis Slots

All Cisco ASR 9010 Router chassis line cards and RSP cards are front facing and mounted vertically, with injector/ejectors and retention screws at top and bottom of each card.

All Cisco ASR 9006 Router chassis line cards and RSP cards are front facing and mounted horizontally, with injector/ejectors and retention screws at the left and right ends of each card.

The chassis cards include:

- Two Route Switch Processor (RSP) cards
- Ethernet line cards:
  - Cisco ASR 9010 Router - eight Ethernet line cards

- Cisco ASR 9006 Router - four Ethernet line cards
- One backplane
- One Backplane Identification (BPID) board
- Two fan controller boards
- Power shelves:
  - Cisco ASR 9010 Router - one or two AC power shelves (in AC-powered systems), or one or two DC power shelves (in DC-powered systems)
  - Cisco ASR 9006 Router - one AC power shelf (in AC-powered systems), or one DC power shelf (in DC-powered systems)

The line card slots are dedicated only to line cards; RSP cards cannot occupy these slots. The RSP slots are dedicated RSP slots; line cards cannot occupy these slots. A keying mechanism keeps line cards from entering RSP slots, and RSP cards from entering line card slots. These keying pins engage before the card alignment pins engage.

Field Replaceable Units

The following components are field replaceable units (FRUs):

- Chassis
- All cards
- Power modules
- Fan trays
- Air filters
- Line card and RSP blank fillers
- Compact flash disk
- SFP and XFP modules
- Optional card cage door

Note The backplane and BPID are not field replaceable units.

Fiber and Interface Cable Management

Card interface cables are managed in the front of the chassis using a cable management tray, as shown in Figure 1-7.

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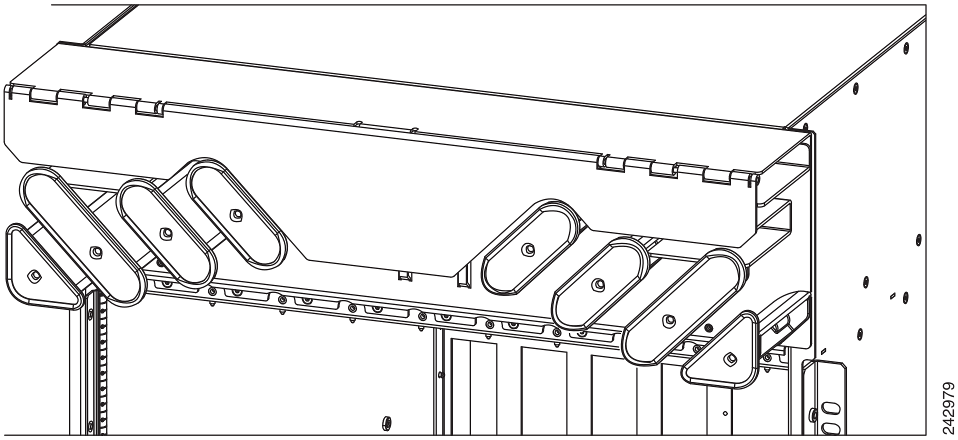
Figure 1-7 Cable Management Tray



The cable management tray is located above the card cage and does not interfere with the insertion or removal of cards. A hinged cover at the top of the tray can be raised for ease of access for routing cables.

Line cards and RSP cards share the same cable management tray. A card must be disconnected prior to its removal (this does not affect adjacent cards). Removal of a line card or RSP card does not require removal or adjustment of cables other than those associated with the card itself.

Sufficient horizontal cable management is provided to accommodate a fully populated chassis with eight 40xGigE line cards using 1.6 mm optical fiber.

A cable management bend radius of 1.5 inches (3.81 cm) bend radii is accommodated. Line card slots at the extreme ends of the cable management trays use space outside of the chassis width to accommodate the 1.5-inch (3.81-cm) radii due to limited space per slot.

Space for the fiber bend radii and strain relief is 3.75 inches (9.53 cm) in front of the faceplate.

Fiber and cables are routed upwards away from slot number labels, as shown in Figure 1-8. Therefore slot number labels, located at the lower part of the card cage, are not obscured by the cables.

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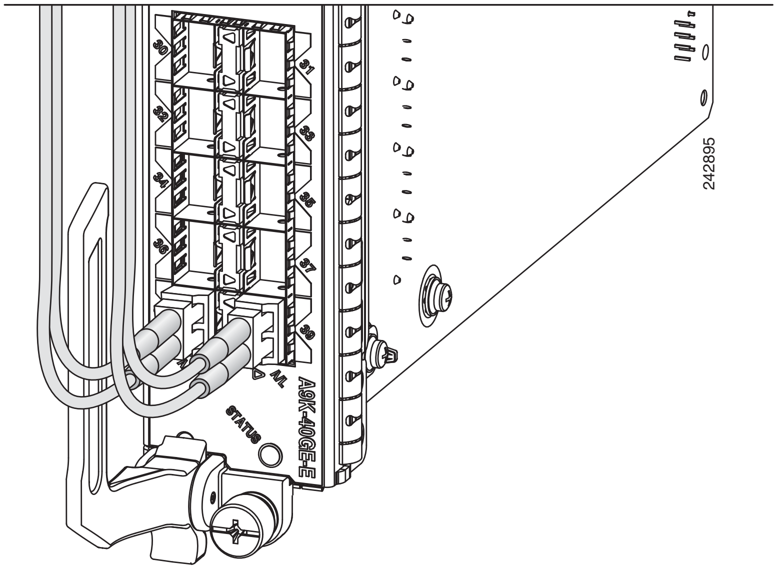
Figure 1-8   Fiber/Cable Routing in the Cisco ASR 9010 Router

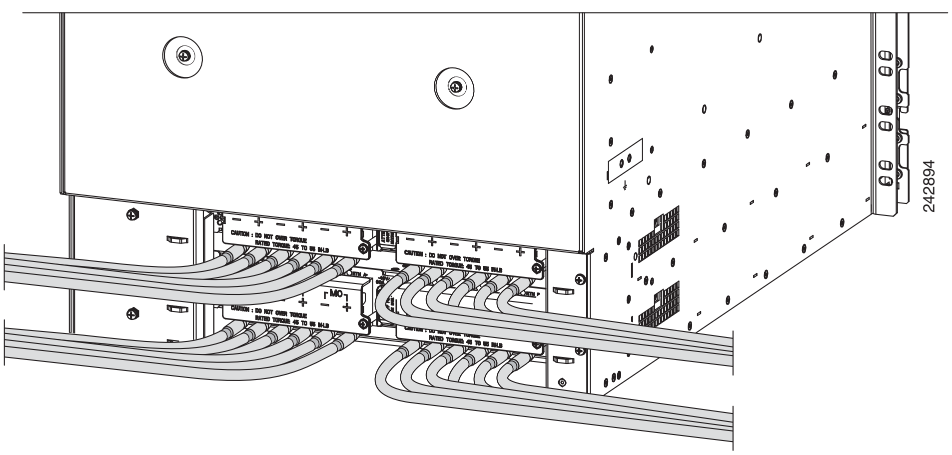


DC Power Shelf Source Cable Routing

Power cables are located in the rear. The A and B source feeds to the DC power supply modules are separated so the cables route to opposite sides of the chassis. A cable tie down point is provided.

Figure 1-9 shows the DC power cable routing for the Cisco ASR 9010 Router having two power shelves. The Cisco ASR 9006 Router is similar, but has only one power shelf.

Figure 1-9   DC Power Shelf Source Cable Routing



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Slot Numbering and Marking

All card slots are clearly numbered. Labels identifying slots are visible from the front of the chassis and are clearly numbered below each slot. As mentioned previously, fiber and cables are routed upward and do not obscure the slot ID labels.

Figure 1-13 shows the slot ID numbering for the Cisco ASR 9010 Router.

Figure 1-10 ASR 9010 Router Slot ID Numbering

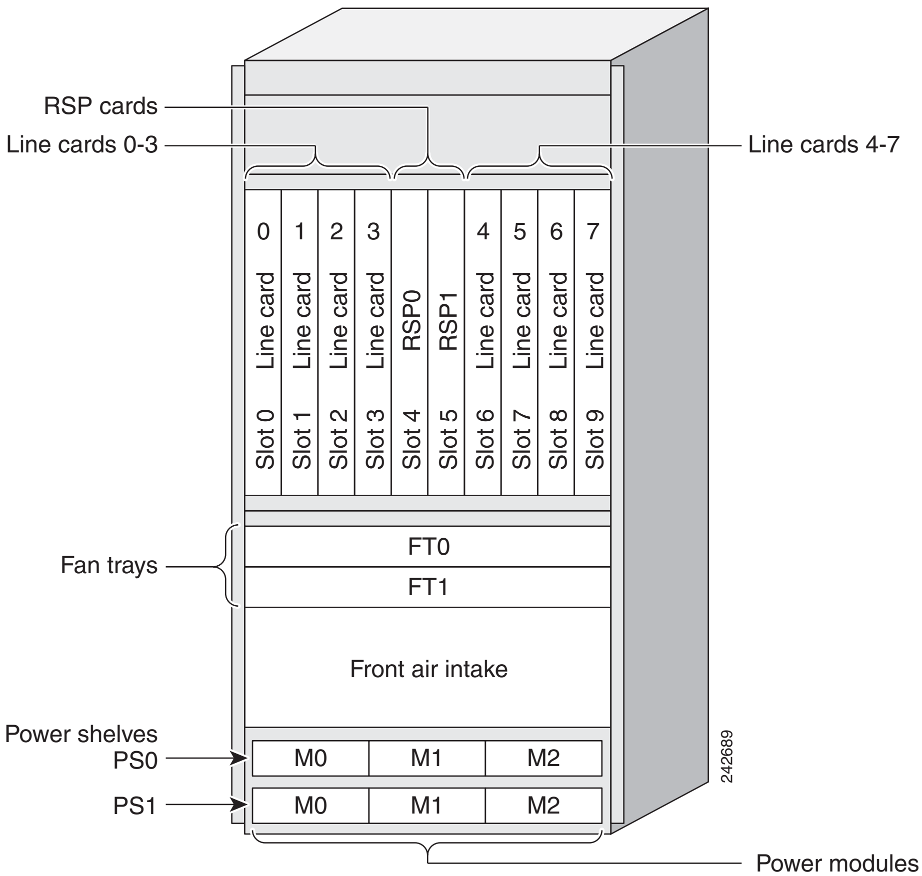

Figure 1-11 shows the slot ID numbering for the Cisco ASR 9006 Router.

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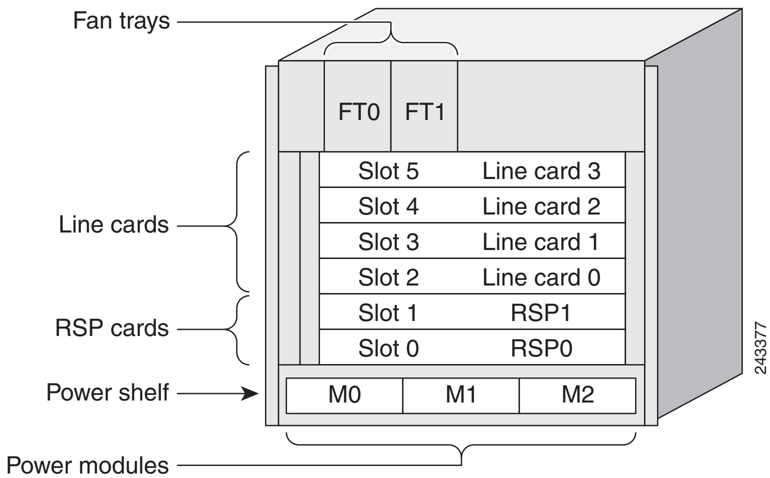
Figure 1-11 ASR 9006 Router Slot ID Numbering



Route Switch Processor (RSP) Card Overview

The Route Switch Processor (RSP) card is the main control and switch fabric element in the Cisco ASR 9000 Series chassis. There can be two RSP cards in the system. One is the active control RSP and the other is the standby control RSP.

RSP Cards Front Panel and Access Ports

System alarms reside on the RSP. Alarms will consist of visual indicators with three levels, Critical (red), Major (red), and Minor (yellow). There is a console interface for remote viewing of alarms and fault information. The RSP has the following information and alarm LEDs and connectors:

- One external Compact Flash type I/II
- Two EIA/TIA-232 RJ232 serial RJ-45 ports: one each for Console and Auxiliary modem ports, with Manufacturing Test connections to the backplane
- Two triple speed 10/100/1000Mbit Ethernet Management ports.
- One 4 character 5x7 LED dot matrix display and discrete status LEDs
- Alarm Cut Off/Lamp test momentary push button switch
- Two RJ-45 Sync timing ports with Link and Fault LEDs built into the RJ-45
- Alarm Output DB9 port with 3 alarm outputs

Figure 1-12 shows the front panel of the RSP card.

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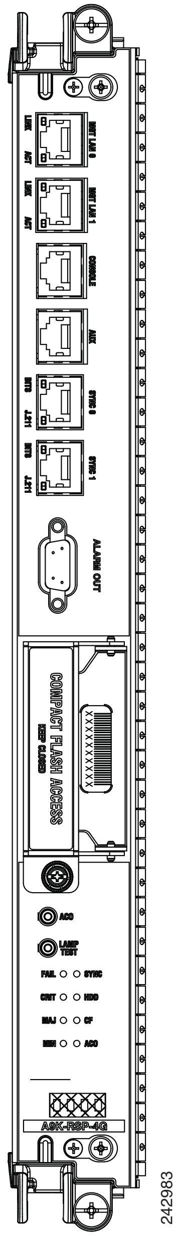
Figure 1-12 RSP Card Front Panel



Management Features

Two management LAN ports (MGT LAN 0, MGT LAN 1) are provided on the RSP front panel. These are triple-speed RJ-45 connectors for use as out-of-band management ports.

An Auxiliary (AUX) port and Console port are also provided on the RSP front panel. These are EIA/TIA-232 (also known as RS-232) asynchronous serial ports for connecting external devices to monitor and manage the system.

The RSP card front panel also has a two synchronization (Sync) timing ports that can be configured as BITS or J.211 ports. These ports provide connections for external timing and synchronization sources.

The SYNC ports are not currently supported. They are provided for future release functionality.

Alarm Connector

Each RSP card drives a set of three alarm output contacts. Alarm circuitry on the RSP card activates dry contact closures that are accessible through a nine-pin connector on the RSP faceplate. Both normally open and normally closed contacts are available.

Serviceability

RSP cards can be inserted or removed when adjacent (cabled) RSP or line cards are installed. Compact Flash is serviceable without the need to remove the RSP card. Servicing the hard drive requires removal of the RSP card.

Ejector/Insertion Levers

Ejector/insertion levers are provided for inserting and removing the RSP cards. The insertion and removal force of the card ejectors is about 16 lb (7.27 kg). Longer ejectors are provided for the RSP cards than for the line cards due to the higher pin count of the RSP card.

Ethernet Line Cards Overview

The set of three line cards for the Cisco ASR 9000 Series Routers is based on a single, 40G base card containing the processors, fabric interface, power, and forwarding circuitry. Mounted on the base card are one of three daughter cards containing I/O circuitry:

- A 40-port Gigabit Ethernet with SFP (small form factor pluggable) optics
- A 4-port 10Gigabit Ethernet line rate card with XFP (10GE SFP) optics
- An 8-port 10Gigabit Ethernet oversubscribed card with XFP optics.

For line card installation information, see the *Cisco ASR 9000 Series Aggregation Services Routers Ethernet Line Cards Installation Guide.*

Line Card Front Panel and Access Ports

Each line card drives a set of three alarm output contacts, one set for each of Critical, Major and Minor. Alarm circuitry on the RSP activates dry contact closures that are accessible through a nine-pin connector on the RSP faceplate.

See "Ethernet Line Cards" section on page 2-11 for a description of each line card's front panel indicators and their meaning.

Line Card Serviceability

Line cards can be inserted or removed when adjacent (cabled) RSP or line cards are installed.

Line Card Ejector/Insertion Levers

Ejector/insertion levers are provided for inserting and removing line cards from the backplane connectors. Insertion and removal force of the card ejectors is about 16 lb (7.27 kg).

Power System Overview

The Cisco ASR 9000 Series Routers can be powered with an AC or DC source power. The power system provides power for the cards and fan trays.

The power system is based on a distributed power architecture centered around a –54 VDC printed circuit power bus on the system backplane.

The –54 VDC system backplane power bus can be sourced from one of two options:

- AC systems: An AC/DC bulk power supply shelf connected to the customer's 180 to 264 VAC source
- DC systems: An DC/DC bulk power supply shelf connected to the customer's Central Office DC battery source (–54 VDC nominal).

DC output power from each power shelf is connected to the router by two power blades that mate to the power bus on the backplane. The system backplane distributes DC power through connectors on the single –54 VDC distribution plane to each card and the fan trays. Each card has on-board DC-DC converters to convert the –54 VDC from the distribution bus voltage to the voltages required by each particular card.

AC and DC Power Modules

Each AC or DC shelf houses up to 3 power modules. The AC power shelves provide 1+1 redundancy; DC power shelves provide N+1 redundancy. Required power inputs types for each module type are:

- AC shelf: single phase AC multiple input
- DC shelf: dual source DC input

The power shelves drive a single output bus that delivers –54 V to all cards and fan trays that are plugged into the backplane.

Figure 1-13 shows a front view of six power modules installed in the two power shelves of the Cisco ASR 9010 Router. Since it has only one power shelf, the Cisco ASR 9006 Router can have a maximum of three power modules installed.

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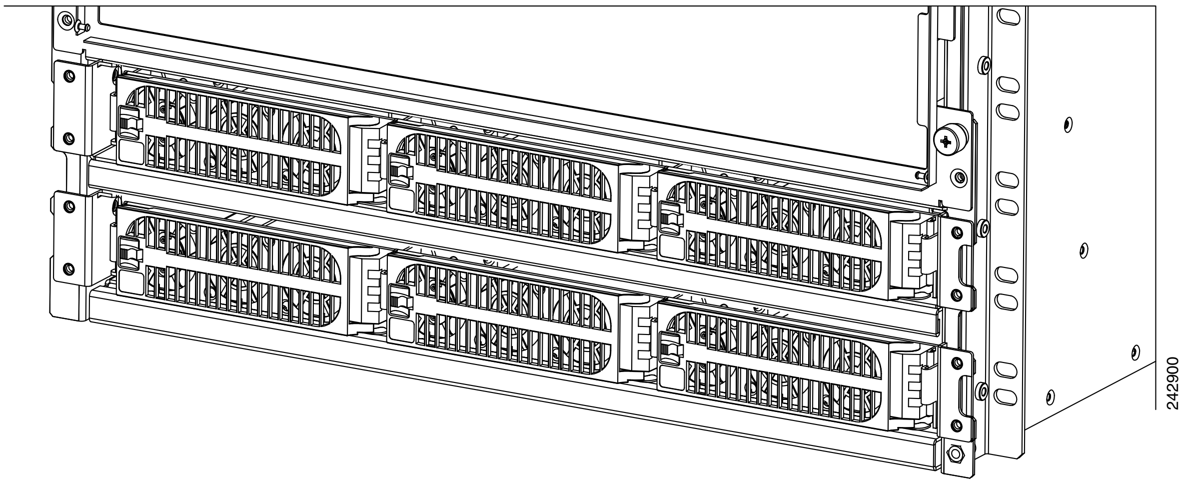
Figure 1-13 Front System View of Power Shelves



Cooling System Overview

The Cisco ASR 9000 Series chassis is cooled by two fan trays. The two fan trays provide full redundancy and maintain required cooling if a single fan failure should occur.

In the Cisco ASR 9010 Router, the fan trays are located one above the other below the card cage, and are equipped with handles for easy removal.

The fan trays for the Cisco ASR 9006 Router are located above the card cage, left of center, side by side. They are covered by a fan tray door hinged at the bottom, which must be opened to remove the trays.

Cooling Path

The Cisco ASR 9010 Router chassis has a front to rear cooling path. The inlet is at the bottom front of the chassis and exhaust is at the upper rear.

Figure 2-24 shows the cooling path for the Cisco ASR 9010 Router chassis.

The Cisco ASR 9006 Router chassis has a side to top to rear cooling path. The inlet is at the right side of the chassis and exhaust is at the upper rear.

Figure 2-24 shows the cooling path for the Cisco ASR 9006 Router chassis.

Fan Trays

The system contains two fan trays (Figure 2-26 and Figure 2-26) for redundancy. In the event of a fan tray failure condition, it is possible to swap a single fan tray assembly while the system is operational. Fan tray removal does not require removal of any cables. The fan tray has an LED indicator to indicate fan tray status.

Management and Configuration

The Cisco ASR 9000 Series Routers run IOS XR software and use the system manageability architecture of that operating system. The system management interfaces consist of the following three protocols running on the Cisco ASR 9000 Series Routers:

- CLI - Command Line Interface
- XML - Extensible Markup Language
- SNMP - Simple Network Management Protocol

By default, only CLI on the console is enabled.

Craft Works Interface (CWI), a graphical craft tool for performance monitoring, is embedded with the Cisco IOS XR software and can be downloaded through the HTTP protocol. A user can use CWI to edit the router configuration file, open Telnet/SSH application windows, and create user-defined applications.

CHAPTER 2

Functional Description

This chapter provides a functional description of the Cisco ASR 9000 Series Router, the Route Switch Processor (RSP) cards, the Ethernet line cards, the power and cooling systems, as well as various subsystems, such as management and configuration, and alarms and monitoring.

This chapter includes the following sections:

Router Operation

The Cisco ASR 9000 Series Router are fully distributed routers using a switch fabric to interconnect a series of chassis slots, each of which can hold one of several types of line cards. Each line card in the Cisco ASR 9000 Series has integrated input/output (I/O) and forwarding engines, plus sufficient control plane resources to manage line card resources. Two slots in the chassis are reserved for RSP cards to provide a single point of contact for chassis provisioning and management.

Figure 2-1 shows the platform architecture of the Cisco ASR 9000 Series Router.

Figure 2-1 Cisco ASR 9000 Series Router Platform Architecture

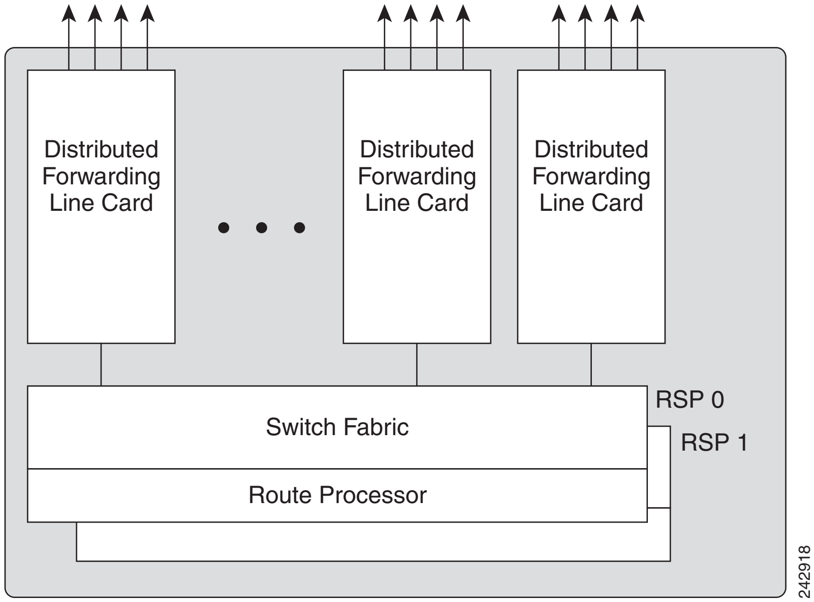
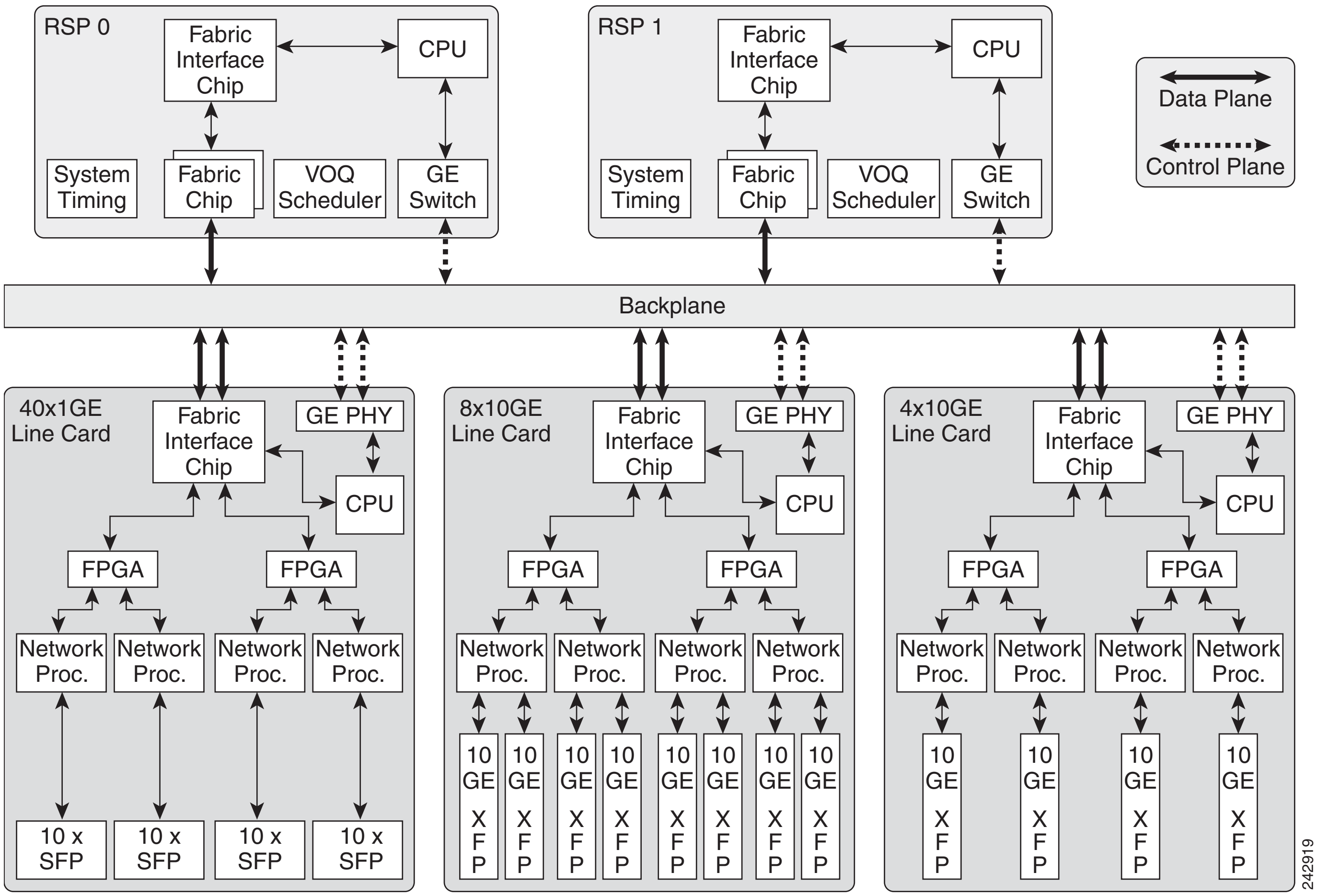


Figure 2-2 shows the major system components and interconnections of the Cisco ASR 9000 Series Router.

Figure 2-2 Major System Components and Interconnections in the Cisco ASR 9000 Series Router



Route Switch Processor Card

The Route Switch Processor (RSP) card is the main control and switch fabric element in the Cisco ASR 9000 Series Router. The RSP card provides system control, packet switching, and timing control for the system.

To provide redundancy, there can be two RSP cards in the system, one as the active control RSP and the other as the standby RSP. The standby RSP takes over all control functions should the active RSP fail.

Figure 2-3 shows the front panel connectors and indicators of the RSP card.

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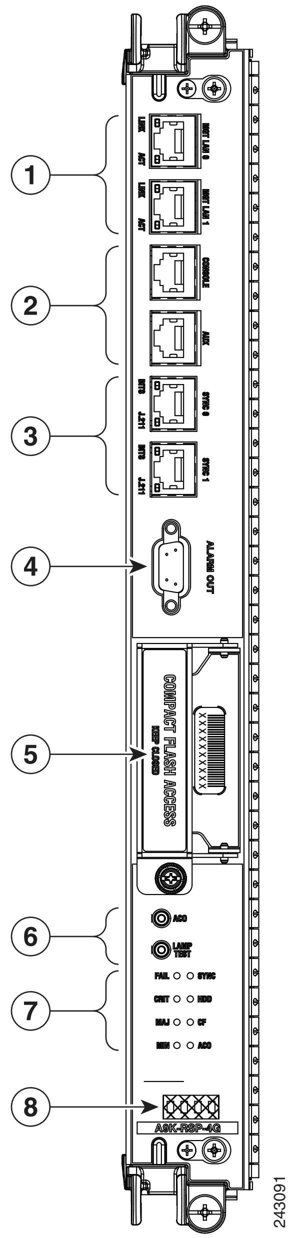
Figure 2-3 RSP Card Front Panel Indicators and Connectors



1	Management LAN ports	**5**	Compact Flash type I/II
2	CONSOLE and AUX ports	**6**	Alarm Cutoff (ACO) and LAMP TEST push buttons
3	Sync (BITS/J.211) ports	**7**	Eight discrete LED indicators
4	Alarm Out DB9 connector	**8**	LED matrix display

Front Panel Connectors

Management LAN Ports

Two triple-speed (10M/100M/1000M) management LAN RJ-45 connectors are provided for use as out-of-band management ports. The speed of the management LAN is autonegotiated.

Console Port

The EIA/TIA-232 RJ-45 Console Port provides a data circuit-terminating equipment (DCE) interface for connecting a console terminal. This port defaults to 9600 Baud, 8 data, no parity, 1 stop bit with software handshake.

Auxiliary Port

The EIA/TIA-232 RJ-45 Auxiliary port provides a data circuit-terminating equipment (DCE) interface that supports flow control. Use this port to connect a modem, a channel service unit (CSU), or other optional equipment for Telnet management. This port defaults to 9600 Baud, 8 data, no parity, 1 stop bit with software handshake.

Alarm Out

Alarm circuitry on the RSP activates dry contact closures that are accessible through the nine-pin Alarm Out connector on the RSP front panel. Each RSP card drives a set of three alarm output contacts. Both normally-open and normally-closed contacts are available.

Only the active RSP drives the alarm outputs. Should a switchover to the standby RSP occur, the newly active RSP drives the alarm outputs.

Synchronization Ports

Note The SYNC ports are not currently supported. They are provided for future release functionality.

The SYNC 0 and SYNC 1 ports are timing ports that can be configured as Building Integrated Timing System (BITS) ports. A BITS port provides a connection for an external synchronization source to establish precise frequency control at multiple network nodes, if required for your application. The RSP card contains a Synchronous Equipment Timing Source (SETS) that can receive a frequency reference from an external BITS timing interface or from a clock signal recovered from any incoming interface, such as a Gigabit Ethernet or 10Gigabit Ethernet interface. The RSP SETS circuit filters the received timing signal and uses it to drive an outgoing Ethernet interface or BITS output port.

The timing port(s) can also be configured as J.211 or UTI ports. A Universal Timing Interface (UTI) port is used to connect to an external UTI server to synchronize timing and frequency across multiple routers. The timing function allows precise synchronization of real-time clocks in a network for measurements of network performance, for example, measuring delay across a VPN. The frequency reference acts like a BITS input.

Front Panel Indicators

The RSP card has eight discrete LED indicators as well as an LED matrix for display of system information.

Table 2-1 shows the display definitions of the eight discrete LEDs on the RSP front panel.

Table 2-1 RSP Discrete LED Display Definitions

Indicator (Label)	Color	Description
Power Fail (FAIL)	Red	Standby Power Fail LED. The LED is turned off by the Controller Area Network (CAN) bus controller after it is up and running.
	Off	Standby power is normal.
Critical Alarm (CRIT)	Red	Critical Alarm LED. A critical alarm has occurred.
	Off (Default after reset)	No critical alarm has occurred.
Major Alarm (MAJ)	Red	Major alarm LED. A major alarm has occurred.
	Off (Default after reset)	No major alarm has occurred.
Minor Alarm (MIN)	Amber	Minor alarm LED. A minor alarm has occurred.
	Off (Default after reset)	No minor alarm has occurred.
Synchronization (SYNC)	Green	Synchronized–Time core is synchronized to an external source.
	Amber	Freerun/Holdover - Time core is in freerun or holdover mode.
	Off (Default after reset)	Time core clock synchronization is disabled.
Internal Hard Disk Drive (HDD)	Green	Hard Disk Drive is busy/active. The LED is driven by the SAS controller.
	Off (Default after reset)	Hard Disk Drive is not busy/active
External Compact Flash (CF)	Green	Compact Flash is busy/active. The LED is driven when the CPU interface FPGA FIFO is not empty and the Compact Flash is selected.
	Off (Default after reset)	Compact Flash is not busy/active.
Alarm Cutoff (ACO)	Amber	Alarm Cutoff has been enabled. The ACO push button was pressed after at least one alarm has occurred.
	Off (Default after reset)	Alarm Cutoff is not enabled.

LED Matrix Display

The LED matrix displays one row of four characters. The matrix becomes active when the CPU powers on and displays the stages of the boot process, as well as displaying runtime information during normal operation. If there are CAN Bus Controller problems, error messages are displayed.

LED Matrix Boot Stage and Runtime Display

The LED matrix displays the stages of the boot process and runtime information as shown in Table 2-2.

Not all of these messages will be seen during a successful boot up process as the screen is updated too quickly for the message to be visible. A failure detected during the boot up process will result in the message remaining visible indicating the stage where the boot up process stopped.

When possible, the RSP card will log the failure information and reboot.

Table 2-2 RSP LED Matrix Boot Stage and Runtime Display

LED Matrix Display	Description
INIT	Card is inserted and microcontroller is initialized.
BOOT	Card is powered on and CPU is booting.
IMEM	Start initializing memory.
IGEN	Start initializing the card.
ICBC	Start initializing communication with the microcontroller.
PD*xy*	Loading programmable devices (*x* = FPGA, *y* = ROMMON).
PST*x*	Power on self test *x*.
RMN	All tests finished and ROMMON is ready for commands.
LOAD	Downloading Minimum Boot Image (MBI) image to CPU.
MBI	Starting execution of MBI.
IOXR	Cisco IOS XR Software is starting execution.
ACTV	RSP role is determined to be active RSP.
STBY	RSP role is determined to be standby RSP.
PREP	Preparing disk boot.

LED Matrix CAN Bus Controller Error Display

The LED matrix will display one of the error messages in Table 2-3 if the RSP card fails one of the power on self tests.

Table 2-3 RSP LED Matrix CAN Bus Controller Status Display

LED Matrix Display	Description
PST1	Failed DDR RAM memory test
PST2	Failed FPGA image cyclic redundancy checking (CRC) check
PST3	Failed card type and slot ID verification

Push Buttons

Two push buttons are provided on the RSP card front panel.

Alarm Cutoff (ACO) - ACO activation suppresses alarm outputs. When the ACO button is pushed while critical alarms are active, the ACO LED turns on and the corresponding alarm output contacts revert to the normally open (non-alarm) state, thus suppressing the alarm. If subsequent critical alarms are detected and activated after the ACO activation, the ACO function is deactivated to notify the user of the arrival of the new alarm(s). In this case, the ACO LED will turn off and any active alarms are again indicated by driving their alarm output contacts to the alarm state.

Lamp Test - When the Lamp Test button is pushed, the RSP status LED, line card status and port LEDs, and Fan Tray LEDs light until the button is released. The LED matrix display is not affected.

Functional Description

The switch fabric and route processor functions are combined on a single RSP card. The RSP card also provides shared resources for backplane Ethernet, timing, and chassis control. Redundant RSP cards provide the central point of control for chassis provisioning, management, and data-plane switching.

Switch Fabric

The switch fabric portion of the RSP card links the Ethernet line cards together. In the ASR 9000, the switch fabric is configured as a single stage of switching with multiple parallel planes. The fabric is responsible for getting packets from one line card to another, but has no packet processing capabilities. Each fabric plane is a single-stage, nonblocking, packet-based, store-and-forward switch. To manage fabric congestion, the RSP card also provides centralized Virtual Output Queue (VOQ) arbitration.

The switch fabric is capable of delivering 80 Gbit/s per slot.

The switch fabric is 1+1 redundant, with one copy of the fabric on each redundant RSP card. Each RSP card carries enough switching capacity to meet the router throughput specifications, allowing for full redundancy.

Figure 2-4 shows the switch fabric interconnections.

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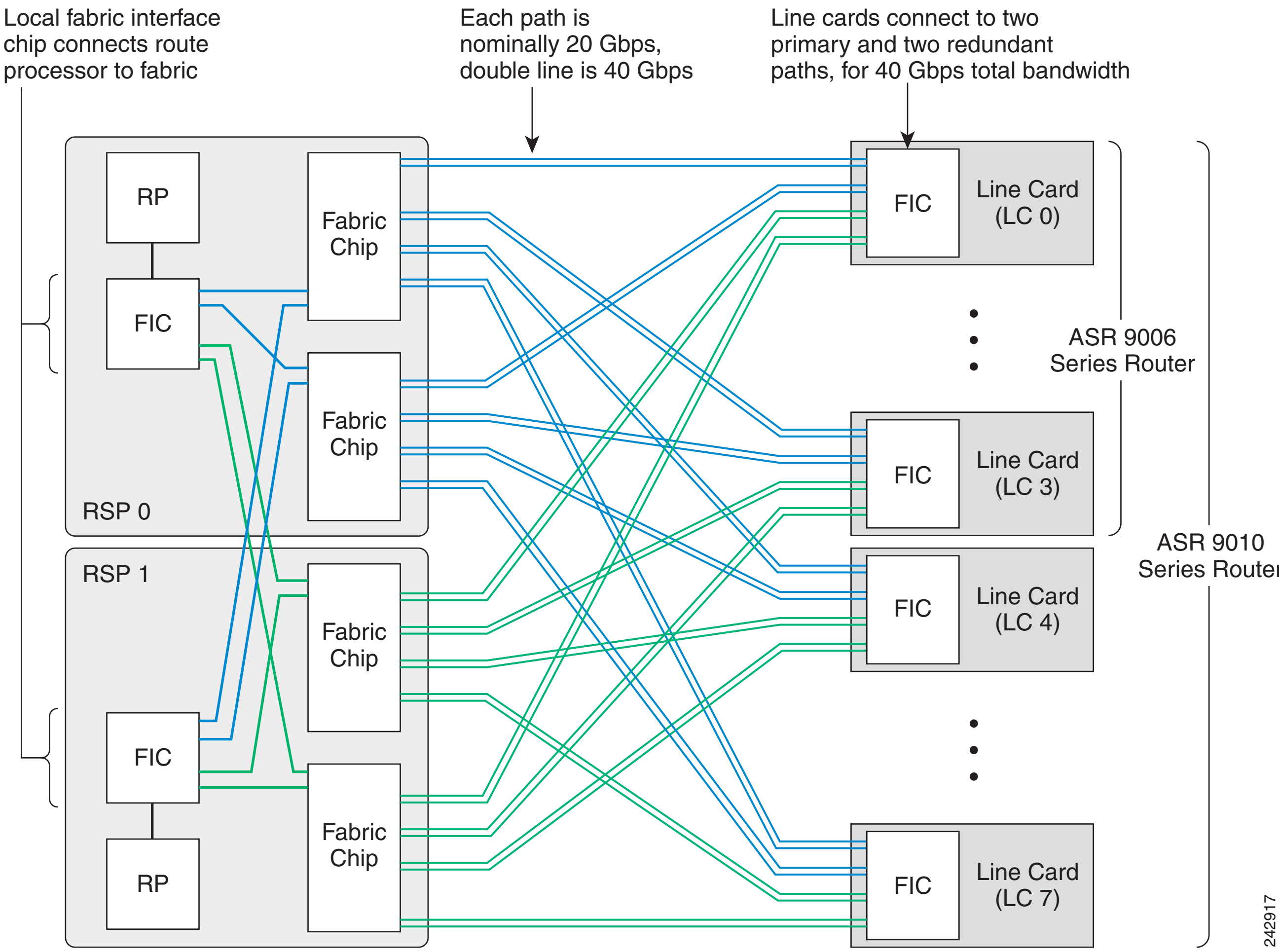
Figure 2-4 Switch Fabric Interconnections



Unicast Traffic

Unicast traffic through the switch is managed by a VOQ scheduler chip. The VOQ scheduler ensures that a buffer is available at the egress of the switch to receive a packet before the packet can be sent into the switch. This mechanism ensures that all ingress line cards have fair access to an egress card, no matter how congested that egress card may be.

The VOQ mechanism is an overlay, separate from the switch fabric itself. VOQ arbitration does not directly control the switch fabric, but ensures that traffic presented to the switch will ultimately have a place to go when it exits the switch, preventing congestion in the fabric.

The VOQ scheduler is also one-for-one redundant, with one VOQ scheduler chip on each of the two redundant RSP cards.

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Multicast Traffic

Multicast traffic is replicated in the switch fabric. For multicast (including unicast floods), the Cisco ASR 9000 Series replicates the packet as necessary at the divergence points inside the system, so that the multicast packets can replicate efficiently without having to burden any particular path with multiple copies of the same packet.

The switch fabric has the capability to replicate multicast packets to downlink egress ports. In addition, the line cards have the capability to put multiple copies inside different tunnels or attachment circuits in a single port.

There are 64K Fabric Multicast Groups in the system, which allow the replication to go only to the downlink paths that need them, without sending all multicast traffic to every packet processor. Each multicast group in the system can be configured as to which line card and which packet processor on that card a packet will be replicated to. Multicast is not arbitrated by the VOQ mechanism, but it is subject to arbitration at congestion points within the switch fabric.

Route Processor Functions

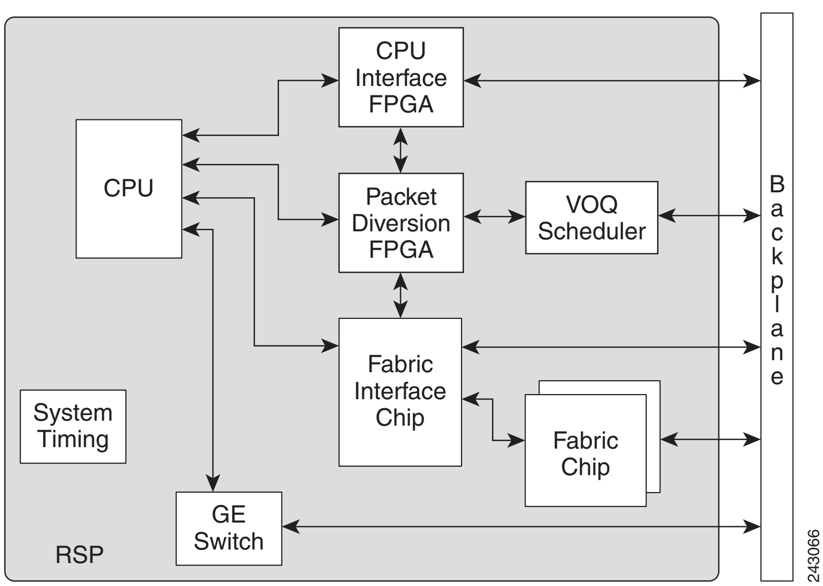
The Route Processor (RP) performs the ordinary chassis management functions. The Cisco ASR 9000 Series runs Cisco IOS XR software, so the RP runs the centralized portions of the software for chassis control and management.

Secondary functions of the RP include boot media, Building Integrated Timing Supply (BITS) timing, precision clock synchronization, backplane Ethernet communication, and power control (through a separate CAN bus controller network).

A key function of the RP is to be able to communicate with line cards and the other RSP card in the chassis through the switch fabric.

Figure 2-5 shows the route processor interconnections.

Figure 2-5 Route Processor Interconnections



Processor-to-Processor Communication

The RSP card communicates with the control processors on each line card through the Ethernet Over Backplane Channel (EOBC) Gigabit Ethernet switch. This path is for processor-to-processor communication, such as IPC (InterProcess Communication). The Active RSP card also uses the EOBC to communicate to the Standby RSP card, if installed.

Route Processor/Fabric Interconnect

To enable communication with the switch fabric, the RSP card has a fabric interface chip attached to the fabric and linked to the route processor through a Gigabit Ethernet interface through a packet diversion FPGA. This path is used for external traffic diverted to the RSP card by line card network processors.

The packet diversion FPGA has three key functions:

- Packet header translation between the header used by the fabric interface chip and the header exchanged with the Ethernet interface on the route processor.
- I/O interface protocol conversion (rate-matching) between the 20 Gbps DDR bus from the fabric interface chip and the 1 Gbps interface on the processor.
- Flow control to prevent overflow in the from-fabric buffer within the packet diversion FPGA, in case of fabric congestion.

Ethernet Line Cards

The Ethernet line cards available for the Cisco ASR 9000 Series Router are listed in Table 2-4.

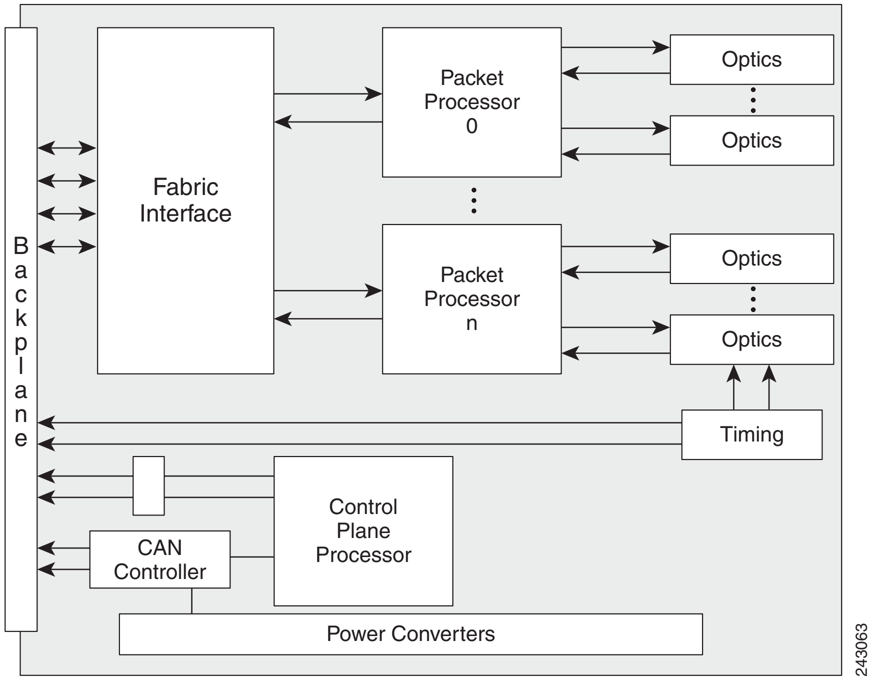
Table 2-4 Ethernet Line Cards Available for the Cisco ASR 9000 Series Router

Line Card	Module Type
40-port Gigabit Ethernet (40x1GE) line card	SFP
8-port10 Gigabit Ethernet (8x10GE) line card	XFP
4-port10 Gigabit Ethernet (4x10GE) line card	XFP

Functional Description

The Ethernet line cards for the Cisco ASR 9000 Series Router provide forwarding throughput of line rate for packets as small as 64 bytes. The small form factor pluggable (SFP or XFP) transceiver module ports are polled periodically to keep track of state changes and optical monitor values. Packet features are implemented within network processor unit (NPU) ASICs (Figure 2-6).

Figure 2-6 General Line Card Data Plane Block Diagram



The 40x1GE line card, 8x10GE line card, and 4x10GE line card have four NPUs per card. There are two data paths from the NPUs. The primary path is to a bridge FPGA, which manipulates the header and does interface conversion, then to the fabric interface ASIC where packets are where packets are queued using VOQ and then sent to the backplane where they flow to the RSP fabric. This path handles all main data and also control data that are routed to the RSP card CPU. The second path is to the local CPU through a switched Gigabit Ethernet link. This second link is used to process control data routed to the line card CPU or packets sent to the RSP card through the fabric link.

The backplane Gigabit Ethernet links, one to each RSP card, are used primarily for control plane functions such as application image download, system configuration data from the IOS XR software, statistics gathering, and line card power-up and reset control.

A CAN bus controller (CBC) supervises power supply operation and power-on reset functions. The CBC local 3.3V regulator uses 10V from the backplane to be operational at boot up. It then controls a power sequencer to control the power-up of the rest of the circuits on the card.

Each NPU can handle a total of approximately 25 to 30 million packets per second, accounting for ingress and egress, with a simple configuration. The more packet processing features enabled, the lower the packets per second that can be processed in the pipeline. This corresponds to up to 15 Gbps of bidirectional packet processing capability for an NPU. There is a minimum packet size of 64 bytes, and a maximum packet size of 9 kB (9216) from the external interface. The NPU can handle frames up to 16kB, and the bridge FPGA and fabric interface chip have been designed to handle a frame size of 10kB.

Packet streams are processed by the NPUs and are routed either locally over the Gigabit Ethernet link to the local CPU or to the RSP fabric card through two bridge FPGAs and the fabric interface chip. The total bandwidth of the path from four NPUs to two bridge FPGAs is 60 Gbps. The total bandwidth of the path from the two bridge FPGAs to the fabric interface chip is 60 Gbps. The total bandwidth from fabric interface chip to the backplane is 46 Gbps redundant. The fabric interface chip connects through four 23 Gbps links to the backplane.

Each NPU can handle up to 15 Gbps of line rate traffic (depending on the packet size and processing requirements). The line cards can handle many different Ethernet protocols to provide Layer2/Layer3 switching. Each NPU can handle 30 Gbps of line rate data in a fully subscribed configuration. All switching between ports is handled on the RSP card, which is connected through the backplane to all line cards. VOQ is implemented in the fabric interface chip both on the line cards and on the RSP card, which assures that all ingress data paths have equal access to their egress data ports.

Although the usable fabric bandwidth over the backplane from the fabric interface ASIC is 80 Gbps, only up to 40 Gbps (usable data) flows over the interface plus any added overhead traffic (46 Gbps).

40x1GE Line Card

The 40x1GE line card has 40 ports connected to SFP modules handling 40 Gigabit Ethernet interfaces through SGMII connections to four NPUs. The 40 SFP ports are organized into four blocks of 10 ports. Each block of 10 ports connect to one NPU through an SGMII serial bus interface.

Figure 2-7 shows the block diagram for the 40x1GE Line card, and Figure 2-8 shows the front panel connectors and indicators.

Figure 2-7 40x1GE Line Card Block Diagram

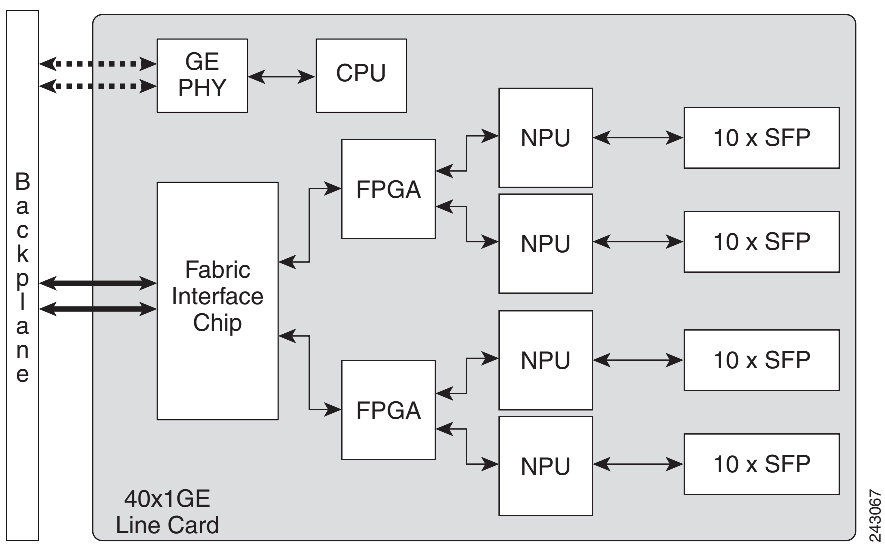


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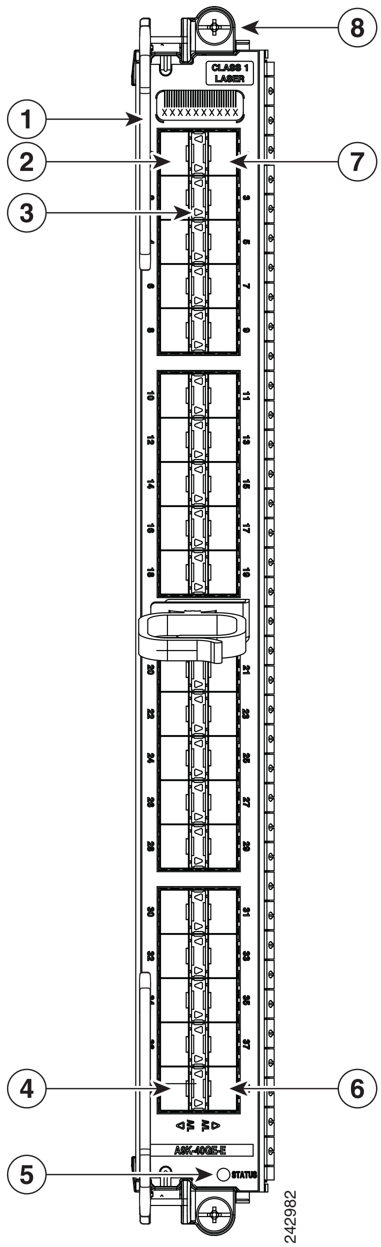
Figure 2-8 40x1GE Line Card Front Panel



1	Ejector lever	**5**	Line Card Status LED
2	Port 0 SFP cage	**6**	Port 39 SFP cage
3	Port Status LED (one per port)	**7**	Port 1 SFP cage
4	Port 38 SFP cage	**8**	Captive installation screw

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8x10GE Line Card

The 8x10GE line card has eight 10 Gigabit Ethernet, oversubscribed, XFP module ports. Two 10 Gigabit Ethernet ports connect to XAUI interfaces on each of the four NPUs.

Figure 2-9 shows the block diagram for the 8x10GE Line card, and Figure 2-10 shows the front panel connectors and indicators.

Figure 2-9 8x10GE Line Card Block Diagram

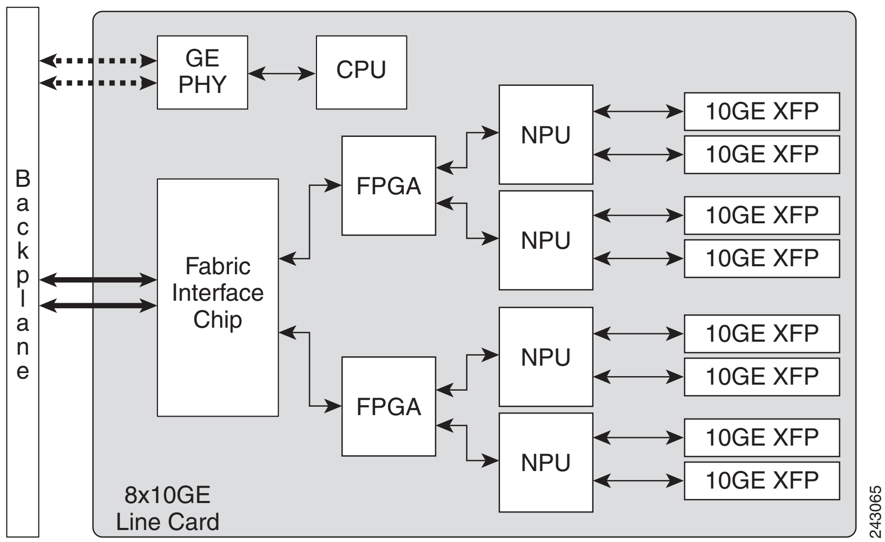
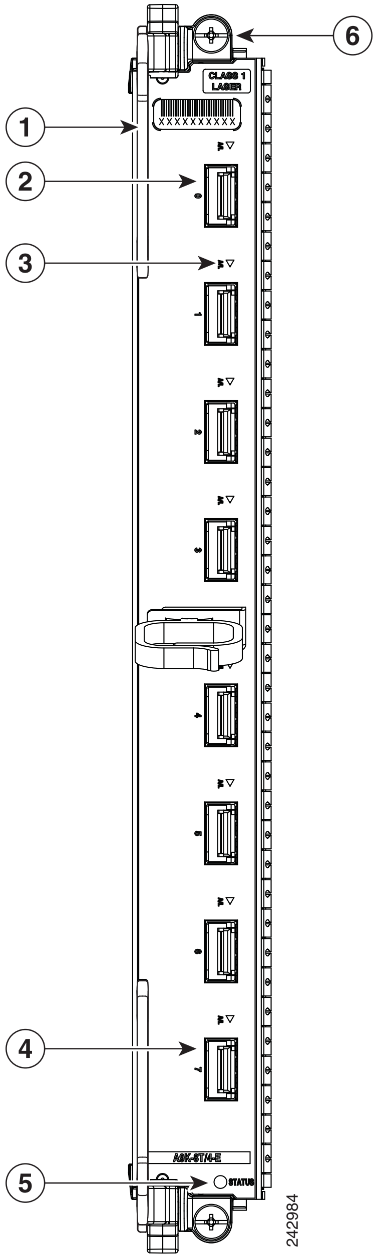


Figure 2-10 8x10GE Line Card Front Panel



1	Ejector lever	**4**	Port 7 XFP cage
2	Port 0 XFP cage	**5**	Line Card Status LED
3	Port Status LED (one per port)	**6**	Captive installation screw

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4x10GE Line Card

The 4x10GE line card has four 10 Gigabit Ethernet XFP module ports. One 10 Gigabit Ethernet port connects to XAUI interfaces on each of the four NPUs.

Figure 2-11 shows the block diagram for the 4x10GE Line card, and Figure 2-12 shows the front panel connectors and indicators.

Figure 2-11 4x10GE Line Card Block Diagram

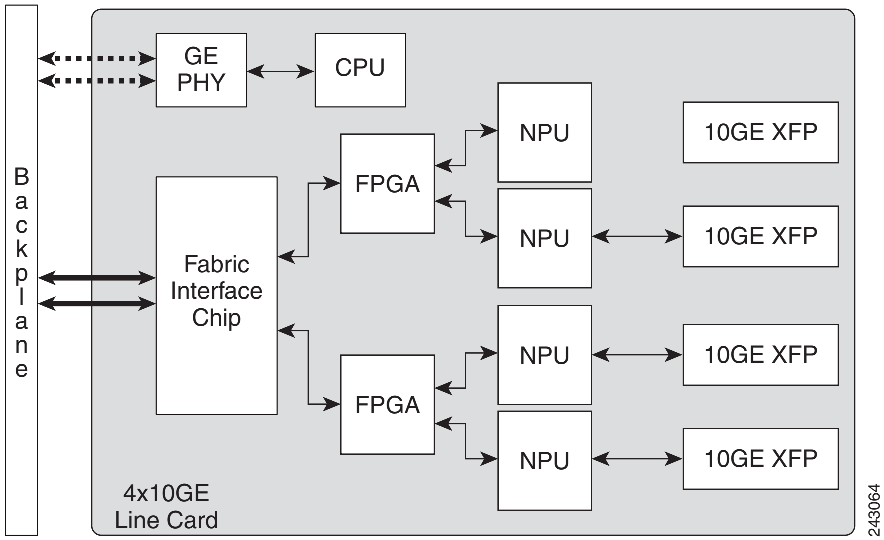

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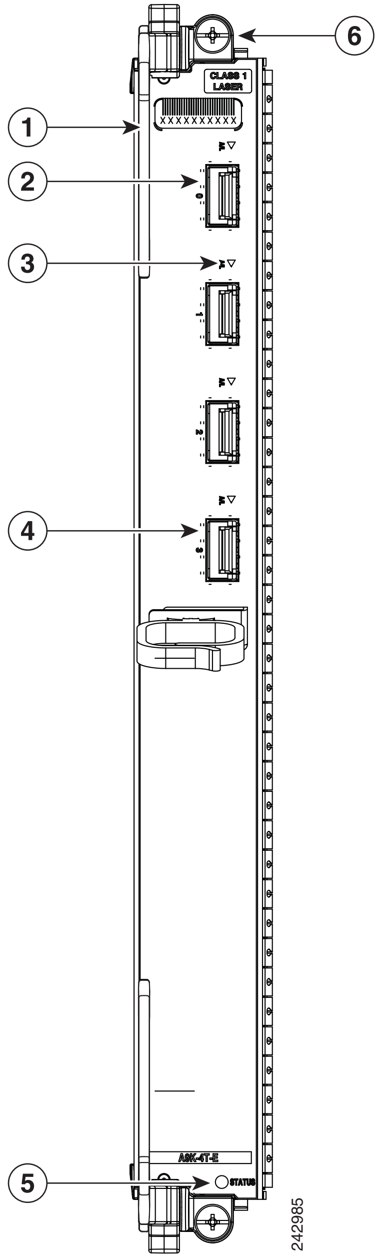
Figure 2-12 4x10GE Line Card Front Panel



1	Ejector lever	**4**	Port 3 XFP cage
2	Port 0 XFP cage	**5**	Line Card Status LED
3	Port Status LED (one per port)	**6**	Captive installation screw

Power System Functional Description

The Cisco ASR 9000 Series Router can be powered with an AC or DC source power. The power system is based on a distributed power architecture centered around a –54 VDC printed circuit power bus on the system backplane.

The –54 VDC system backplane power bus can be sourced from one of two options:

- AC systems: An AC/DC bulk power supply shelf connected to the customer's 180 to 264 VAC source.
- DC systems: An DC/DC bulk power supply shelf connected to the customer's Central Office DC battery source (–54 VDC nominal).

The system backplane distributes DC power from the single –54 VDC distribution plane to each card and the fan trays. Each card has on-board DC-DC converters to convert the –54 VDC from the distribution bus voltage to the voltages required by each particular card.

The power system has single-point grounding on the –54 VDC Return, that is, the –54 VDC Return is grounded to the chassis ground on the backplane only.

All field replaceable modules of the power system are designed for Online Insertion and Removal (OIR), so they can be installed or removed without causing interruption to system operation.

Figure 2-13 is a block diagram of the ASR 9010 AC power system. The ASR 9010 Router DC power system is shown in Figure 2-14.

Figure 2-13 is a block diagram of the ASR 9006 Router AC power system. The ASR 9006 Router DC power system is shown in Figure 2-14.

Figure 2-13 ASR 9010 Router AC Power System Block Diagram

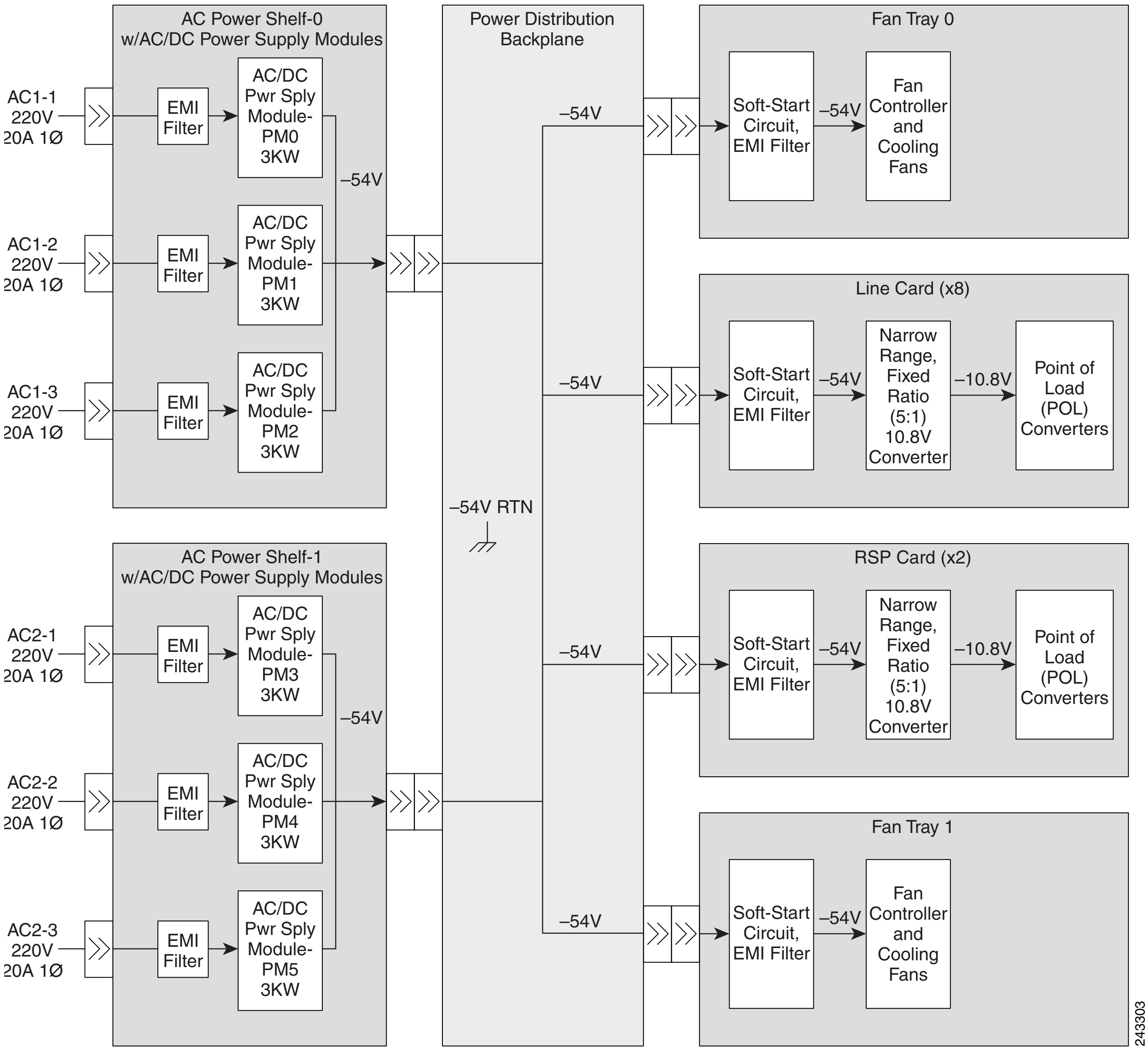


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Figure 2-14 ASR 9010 Router DC Power System Block Diagram

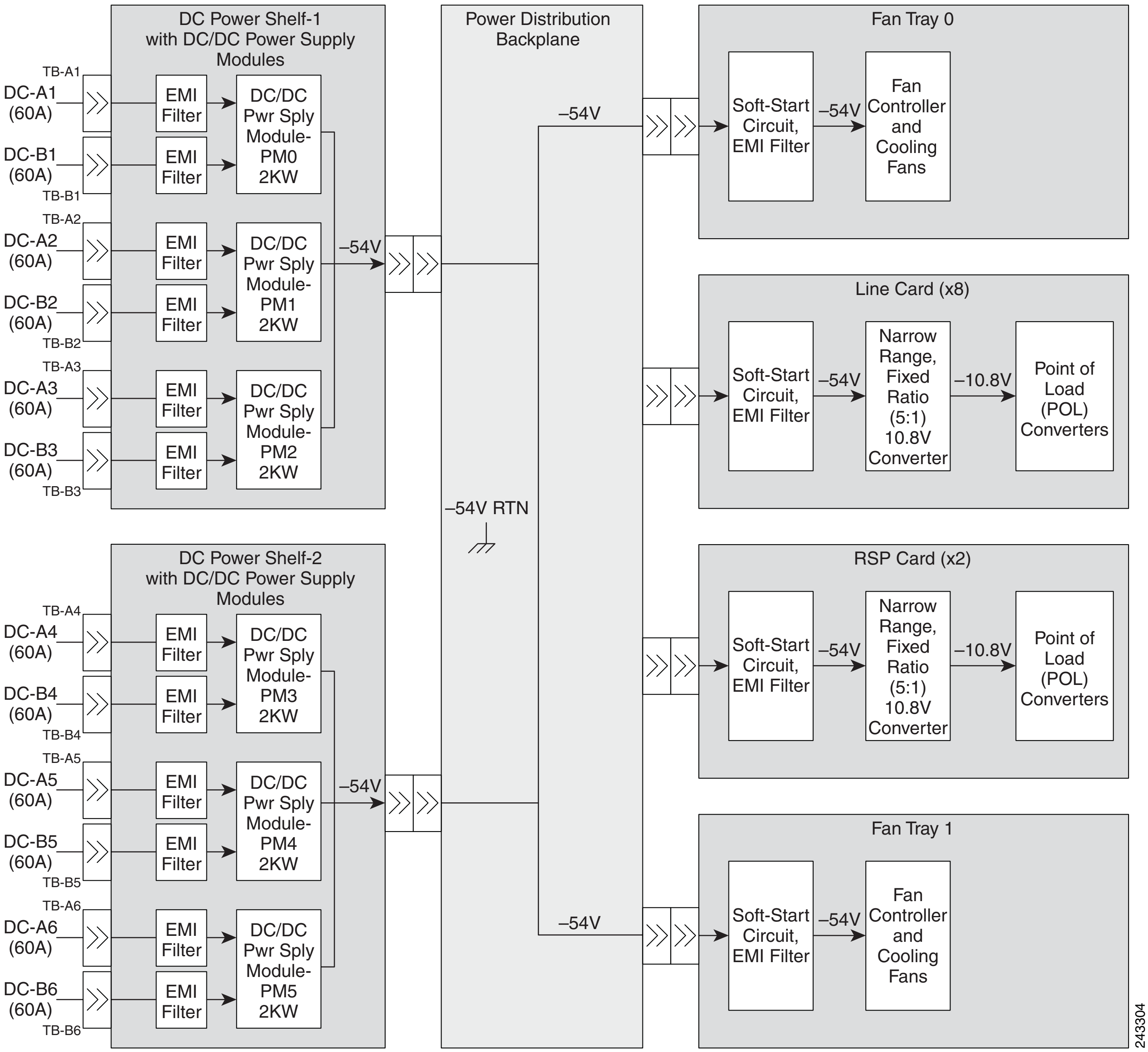

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Figure 2-15 ASR 9006 Router AC Power System Block Diagram

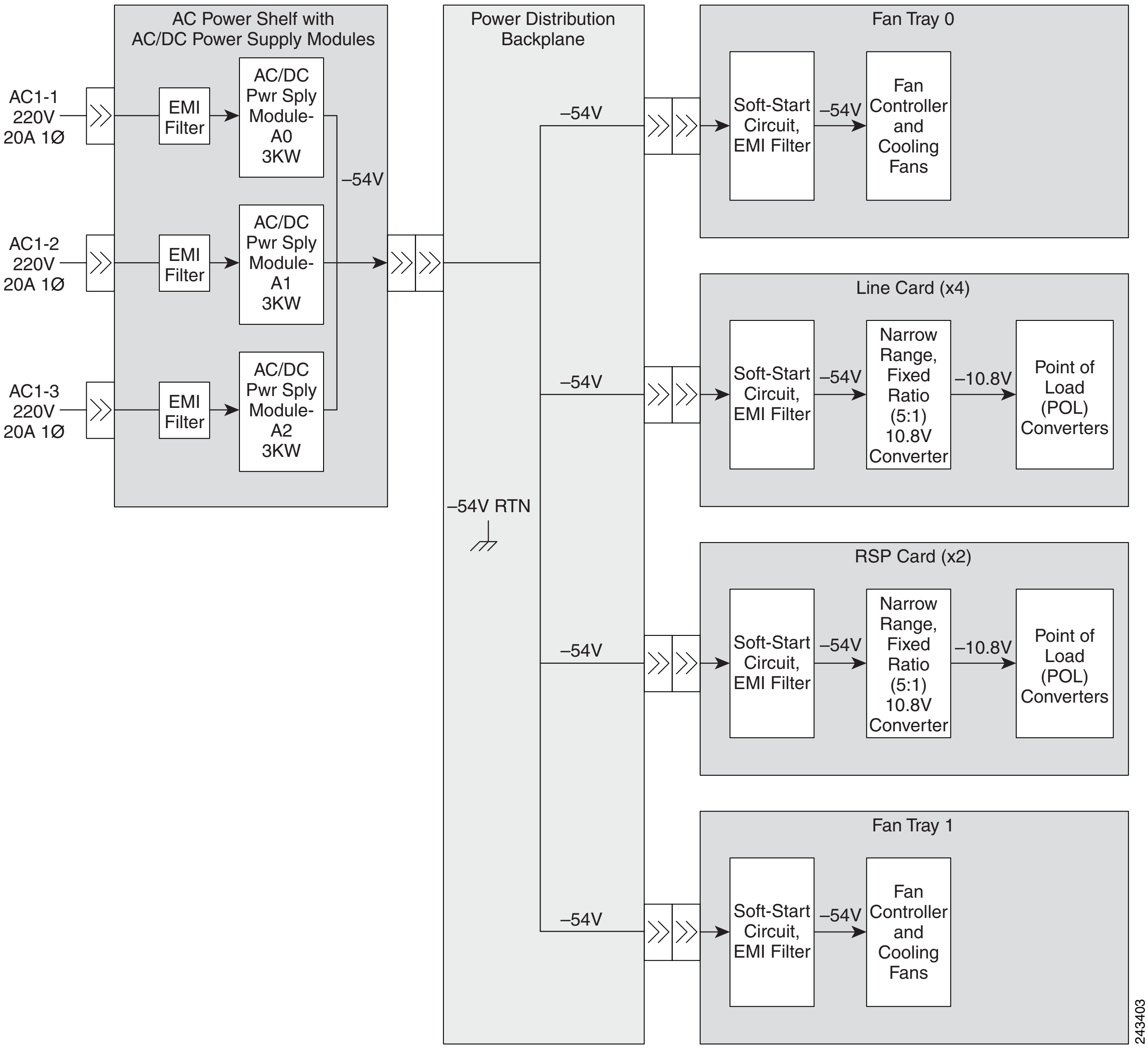

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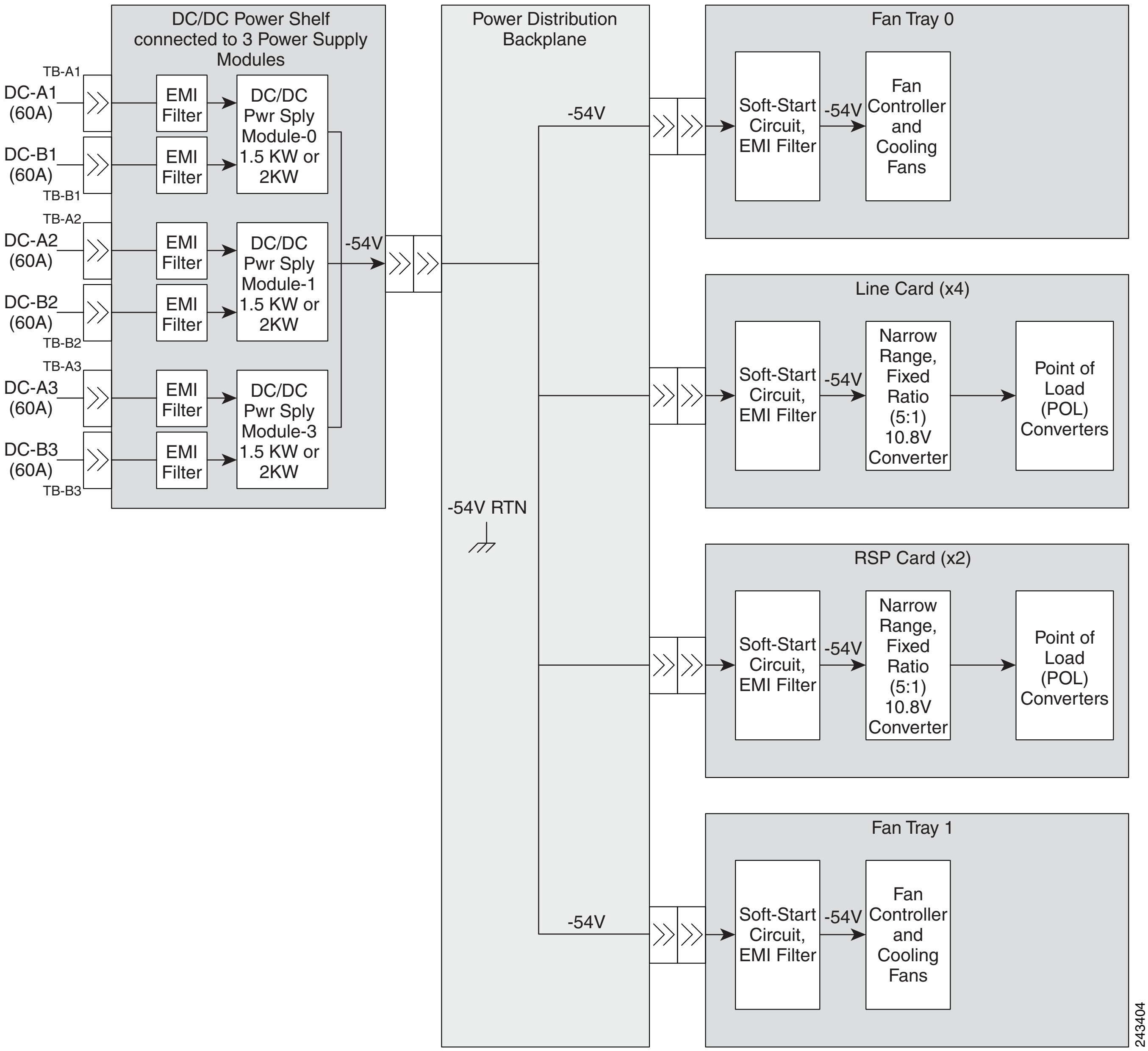
Figure 2-16 ASR 9006 Router DC Power System Block Diagram



System Power Redundancy

Both the AC and DC power systems have full source redundancy and system power redundancy depending on the chassis configuration. Each shelf can house up to three modules and can be configured for multiple power configurations (See Figure 1-13 on page 1-16). For more information about power system redundancy, see the "Power Supply Redundancy" section on page 3-3.

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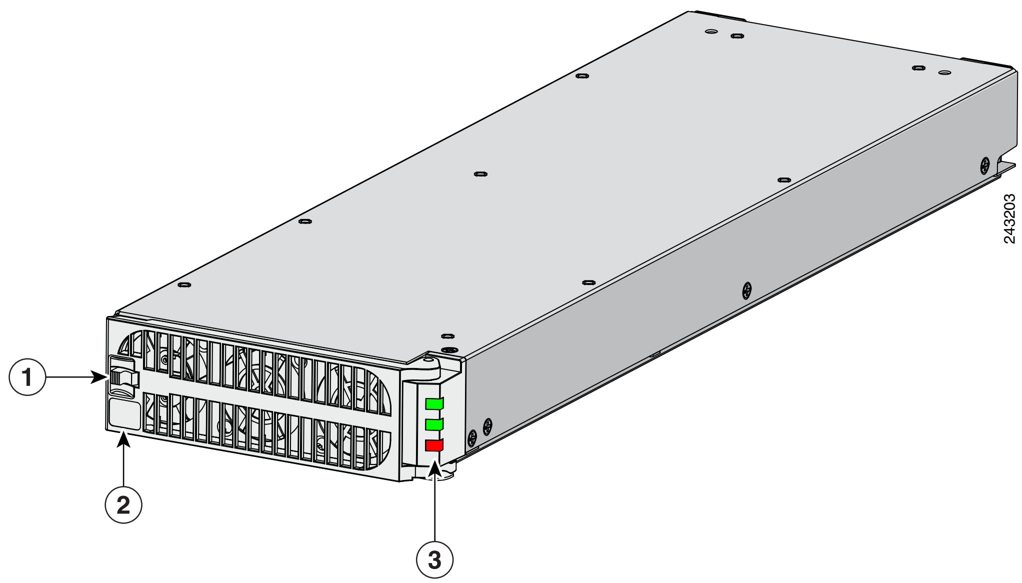
AC Power Modules

Up to three AC/DC power modules (Figure 2-17) can be installed in each AC power shelf. In the ASR 9010 Router, two AC power shelves with a total of six AC power modules can be installed to provide 3 + 3 maximum power redundancy.

In the ASR 9006 Router, one AC power shelf with a total of three AC power modules can be installed to provide 2 + 1 maximum power redundancy.

Figure 2-17 AC Power Module

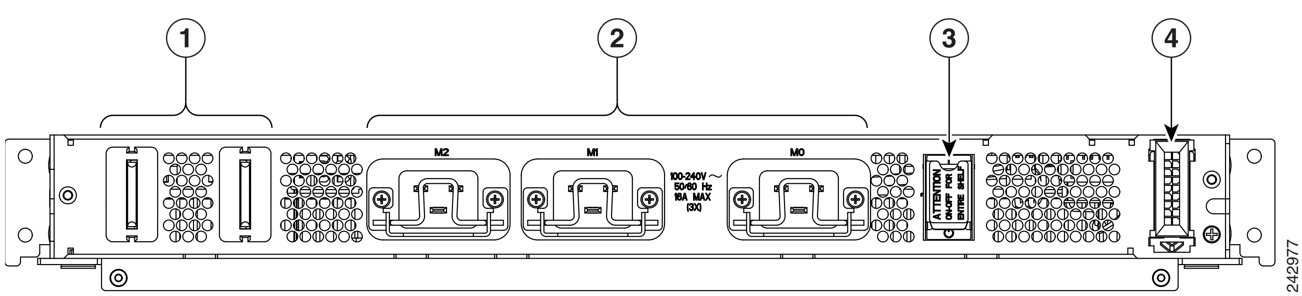


1	Door/ejector latch	**2**	Door/ejector	**3**	LED Indicators

AC Power Shelves

The AC power shelf (Figure 2-18) provides three 20-A UL/CSA-rated, 16-IEC-rated AC receptacles. Each receptacle has a bail lock retention bracket to retain the power cord. DC output power from the AC power shelf is connected to the router by two power blades that mate to the power bus on the backplane. System communication is through a I2C cable from the backplane.

Figure 2-18 AC Power Shelf Rear Panel



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1	DC output power blades	3	Power switch
2	IEC input receptacles with retention brackets	4	I2C cable from backplane

AC Shelf Power Switch

Each AC power shelf provides a single-pole, single-throw power switch to power on and off the three power modules installed in the shelf simultaneously.

AC Input Voltage Range

Each AC module accepts an individual single phase 220-VAC 20-A source. The AC input voltage is anywhere within the limits specified in Table A-7. The voltages given are single phase power source.

DC Output Levels

The output for each module is within the tolerance defined in Table A-9 under all combinations of input voltage variation, load variation and environmental conditions. The combined, total module output power does not exceed 3000 W.

The AC shelf output capacity depends on how many modules are populated. Maximum output current is determined by multiplying the maximum module current times module quantity. For example, to determine the maximum capacity with 3 power supply modules, multiply the current by three (x3).

AC System Operation

This section describes the normal sequence of events for system AC power up and power down.

Power Up

1. AC power is applied to the power shelf by toggling the customer's AC circuit breakers to the ON position.
2. AC/DC power supplies are enabled by toggling the Power On/Off logic switch located in each of the power shelves to the ON position.
3. AC/DC modules in the power shelves provide –54 VDC output within 2 seconds after the AC is applied.
4. The soft-start circuit in the logic cards takes 100 ms to charge the input capacitor of the on-board DC/DC converters.
5. The card power controller MCU enables the power sequencing of the DC/DC converters and points of load (POLs) through direct communication using the PMBus interface to digital controllers.
6. The output of the DC/DC converters ramps up to regulation within 50 ms maximum after the program parameters are downloaded to each POL and the On/Off control pin has been asserted.

Power Down

1. Power conversion is disabled by toggling the Power On/Off logic switch to the OFF position or unplugging the power cords from the AC power source.
2. The AC/DC modules in the power shelves stay within regulation for a minimum of 16 ms after the AC power is removed.

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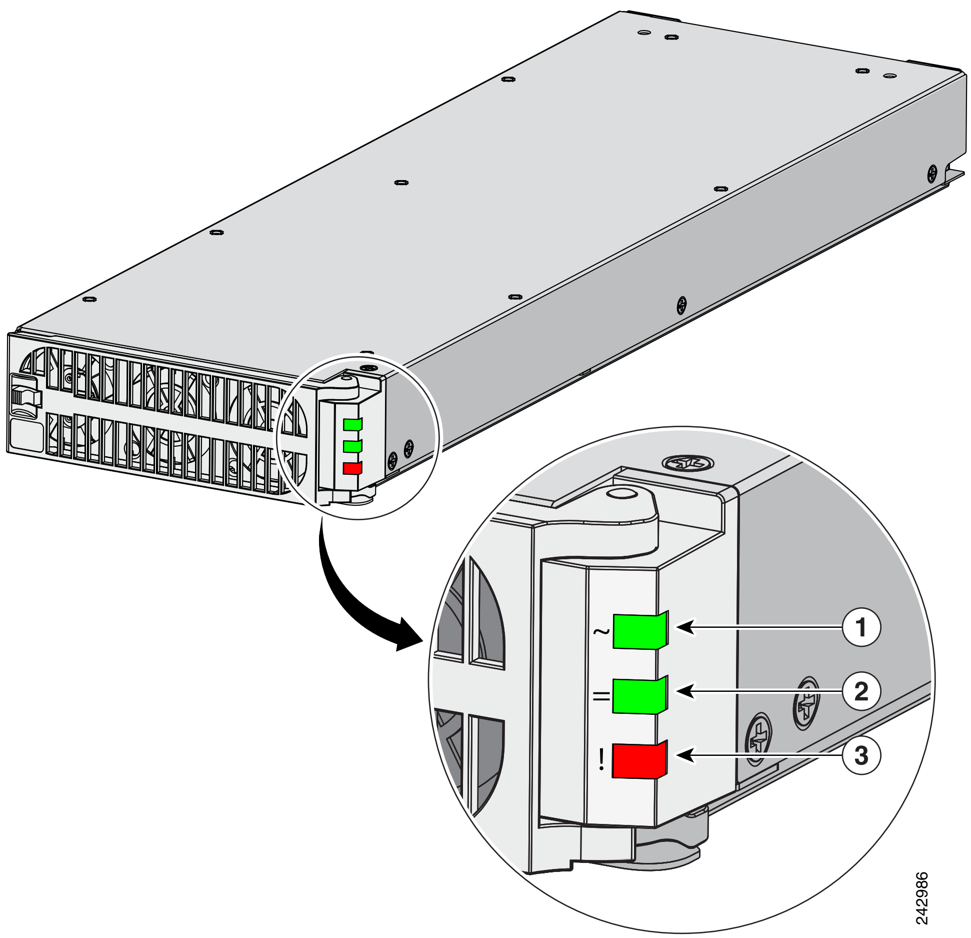
3. The –54 V to the logic card ramps down to –36 V in 15 ms minimum from the time the AC/DC modules starts ramping down from its minimum regulation level.
4. The DC/DC converters turn off immediately after the on/off control pin is deasserted.
5. The output of the DC/DC converters stays in regulation for an additional 100 microseconds.

AC Module Status Indicators

Figure 2-19 shows the status indicators for the AC power module and their definition.

Figure 2-19 AC Module Status Indicators



1	Input LED	ON continuously when the input voltage is present and within the correct range. BLINKING when the input voltage is out of acceptable range. OFF when no input voltage is present.
2	Output LED	ON when the power module output voltage is present. BLINKING when the power module is in a power limit or overcurrent condition.
3	Fault LED	ON to indicate that a power supply failure has occurred.

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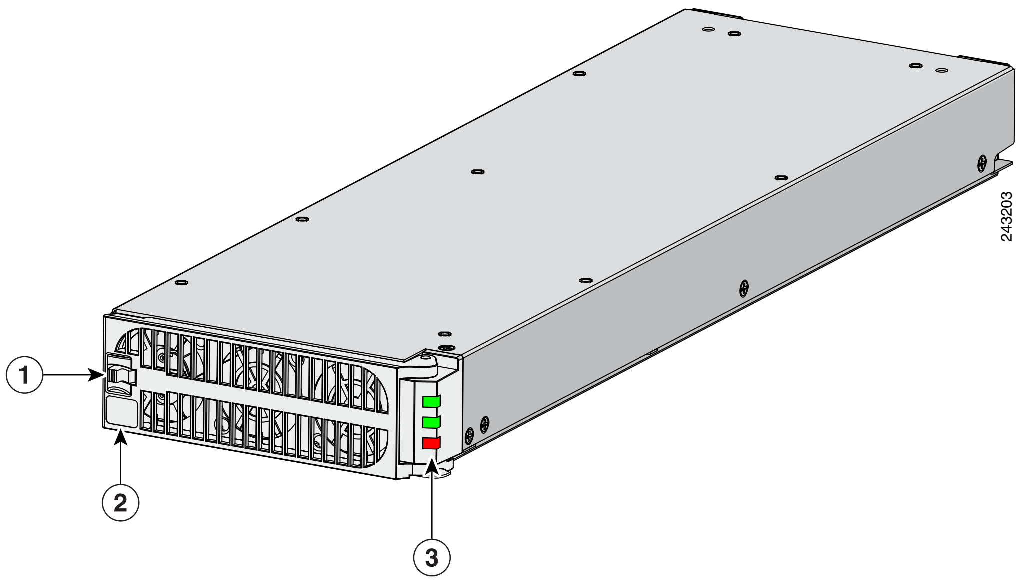
DC Power Modules

Up to three DC/DC power modules can be installed in a DC power shelf. In the ASR 9010 Router, two DC power shelves with a total of six DC power modules can be installed to provide 5 + 1 maximum power redundancy.

In the ASR 9006 Router, one DC power shelf with a total of three DC power modules can be installed to provide 2 + 1 maximum power redundancy.

Figure 2-20 DC Power Module



1	Door/ejector latch	**2**	Door/ejector	**3**	LED Indicators

DC Power Shelves

The DC power shelf (Figure 2-21) provides two power feed connector banks, A feed and B feed. System communication is through a I2C cable from the backplane.

DC Shelf Power Switch

Each DC power shelf provides a single-pole, single-throw power switch to power on and off the three power modules installed in the shelf simultaneously.

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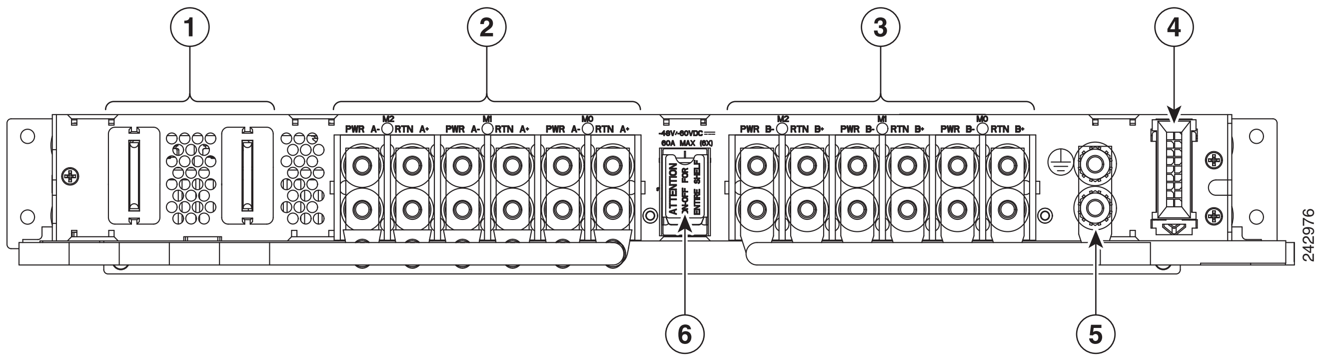
Figure 2-21 DC Power Shelf Rear Panel

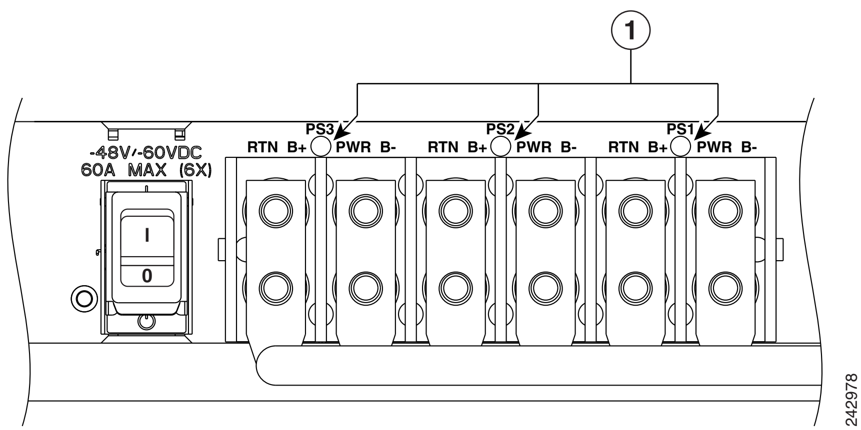


1	DC output power blades	4	I2C cable from backplane
2	"A" feed connectors	5	Primary ground
3	"B" feed connectors	6	Power switch

DC Power Shelf Power Feed Indicator

Figure 2-22 shows the location of the power feed indicators on the rear panel of the DC power shelf.

Figure 2-22 DC Power Shelf Power Feed Indicator

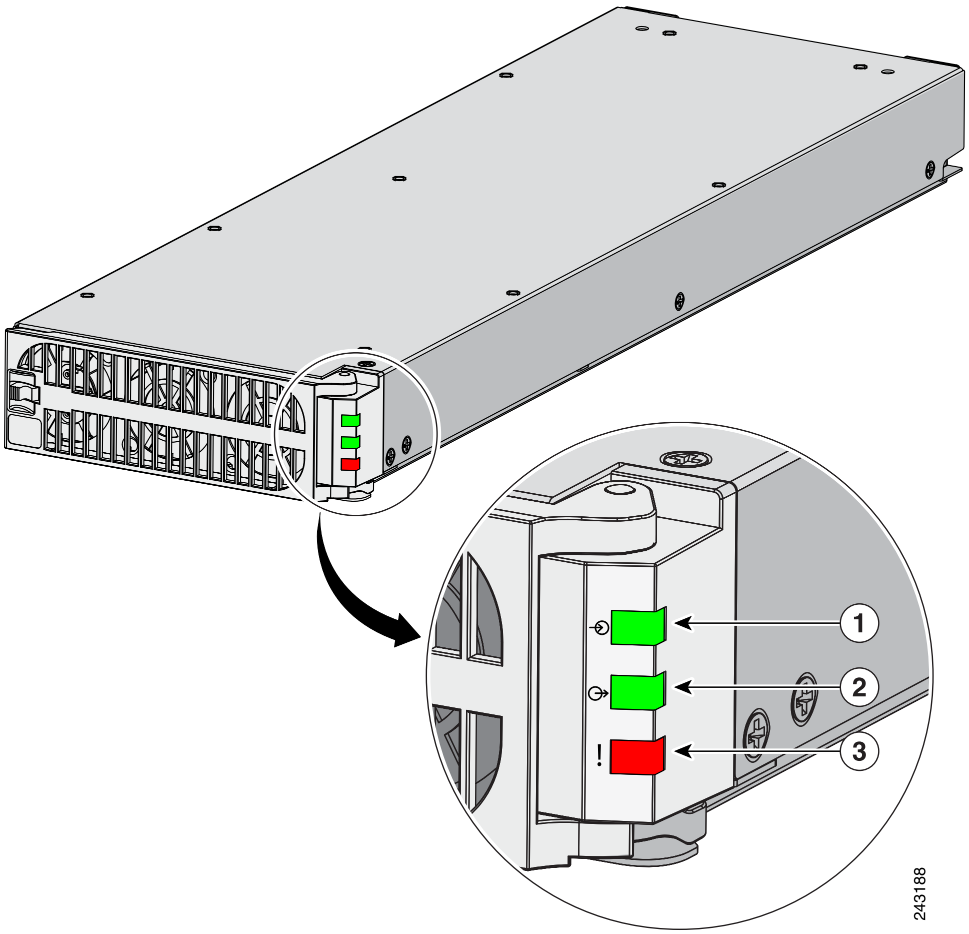


1	Power feed indicators

DC Module Status Indicators

Figure 2-23 shows the status indicator for the DC power module and their definition.

Figure 2-23 DC Module Status Indicators



1	Input LED	ON continuously when the input voltage is present and within the correct range. BLINKING when the input voltage is out of acceptable range. OFF when no input voltage is present.
2	Output LED	ON when the power module output voltage is present. BLINKING when the power module is in a power limit or overcurrent condition.
3	Fault LED	ON to indicate that a power supply failure has occurred.

DC System Operation

This section describes the normal sequence of events for system DC power up and power down.

Power Up

1. DC power is applied to the power shelf by toggling the customer's DC circuit breakers to "ON" position.

2. DC/DC power supplies are enabled by toggling the Power On/Off logic switch located in each of the power shelf to ON position.
3. DC/DC power supply modules in the power shelf provides –54 VDC output within two seconds after the DC is applied.
4. The soft-start circuit in the logic cards takes 100 ms to charge the input capacitor of the on-board DC/DC converters.
5. The card power controller, MCU, enables the power sequencing of the DC/DC converters and POLs through direct communication using a PMBus interface to digital controllers such as LT7510 or through a digital wrapper such as LT2978.
6. The output of the DC/DC converters ramp up to regulation within 50 ms maximum. after the program parameters are downloaded to each POL and On/Off control pin has been asserted.

Power Down

1. Power conversion is disabled by toggling the Power On/Off logic switch in the power shelf to OFF position.
2. The DC/DC modules in the power shelf stays within regulation for a minimum of 5 ms after the Power On/Off logic switch is disabled.
3. The –54V DC to the logic card ramps down to –36 VDC in 3.5 ms minimum from the time the DC/DC modules starts ramping down from its minimum regulation level.
4. The DC/DC converters powers off immediately after the On/Off pin is deasserted.
5. The output of the DC/DC converters stays in regulation for an additional 100 microseconds.

Cooling System Functional Description

The Cisco ASR 9000 Series chassis is cooled by two fan trays located below the card cage. The two fan trays provide full redundancy and maintain required cooling if a single fan failure should occur.

In the ASR 9010 Router, the fan trays are located one above the other below the card cage, and are equipped with handles for easy removal.

The fan trays for the ASR 9006 Router are located above the card cage, left of center, side by side. They are covered by a fan tray door hinged at the bottom, which must be opened to remove the trays.

Cooling Path

The ASR 9010 Router chassis has a front to rear cooling path. The inlet is at the bottom front of the chassis and exhaust is at the upper rear.

Figure 2-24 shows the cooling path for the ASR 9010 Router chassis.

The ASR 9006 Router chassis has a side to top to rear cooling path. The inlet is at the right side of the chassis and exhaust is at the upper rear.

Figure 2-25 shows the cooling path for the ASR 9006 Router chassis.

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Figure 2-24 ASR 9010 Router Chassis Cooling Path

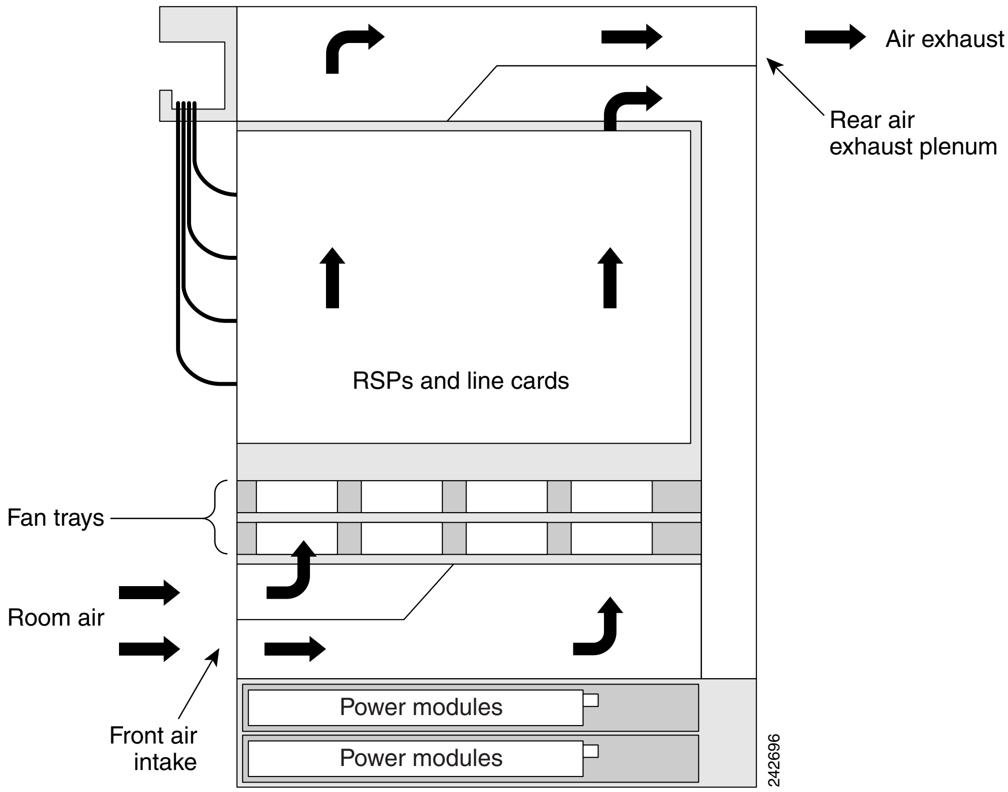
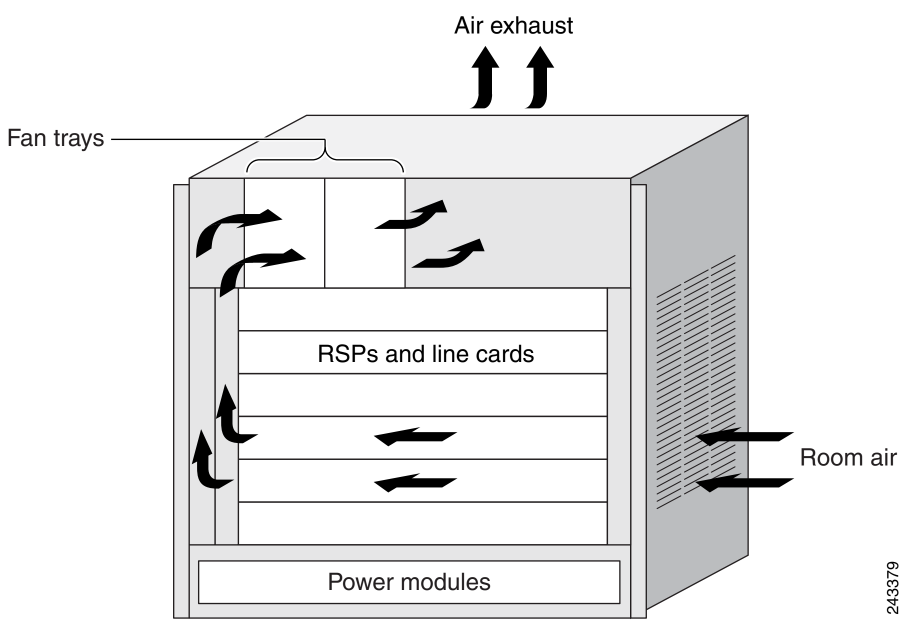


Figure 2-25 ASR 9006 Router Chassis Cooling Path



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Fan Trays

The ASR 9010 Router contains two fan trays (Figure 2-26) for redundancy. In the event of a fan tray failure condition, it is possible to swap a single fan tray assembly while the system is operational. Fan tray removal does not require removal of any cables.

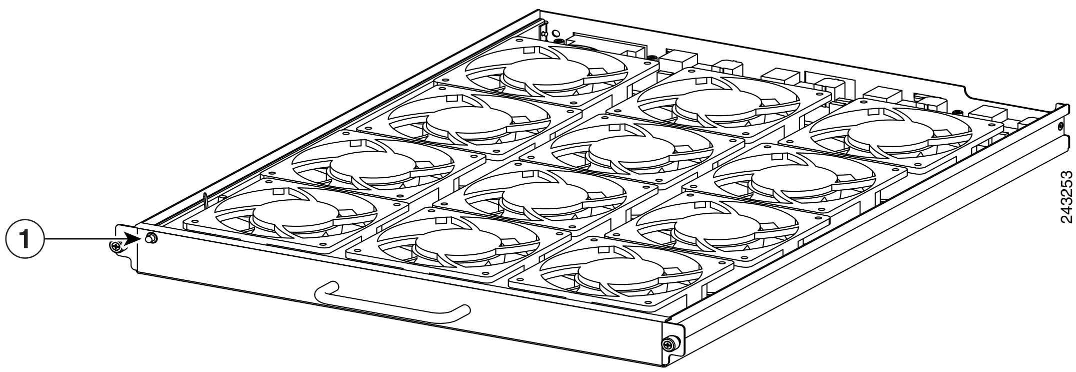
The fan tray contains 12 axial 120-mm (4.72-in) fans. There is a fan control board at the back end of each tray with a single power/data connector that connects with the backplane.

The fan tray aligns through two guide pins inside the chassis, and is secured by two captive screws. The controller board floats within the fan tray to allow for alignment tolerances.

A finger guard is adjacent to the front of most of the fans to keep fingers away from spinning fan blades during removal of the fan tray.

Maximum weight of the fan tray is 13.82 lb (6.29 kg).

Figure 2-26 ASR 9010 Router Fan Tray



1	Fan Tray Status LED

The ASR 9006 Router contains two fan trays (Figure 2-27) for redundancy. In the event of a fan tray failure condition, it is possible to swap a single fan tray assembly while the system is operational. Fan tray removal does not require removal of any cables.

Note For the ASR 9006 Router, both fan trays are required for normal system operation. If one of the two fan trays is pulled out or is not installed, a critical alarm is raised.

The fan tray contains six axial 92-mm (3.62-in) fans. There is a fan control board at the back end of each tray with a single power/data connector that connects with the backplane

The fan tray aligns through two guide pins inside the chassis, and is secured by one captive screw. The controller board floats within the fan tray to allow for alignment tolerances.

A finger guard is adjacent to the front of most of the fans to keep fingers away from spinning fan blades during removal of the fan tray.

Maximum weight of the fan tray is 39.7 lbs (18.0 kg).

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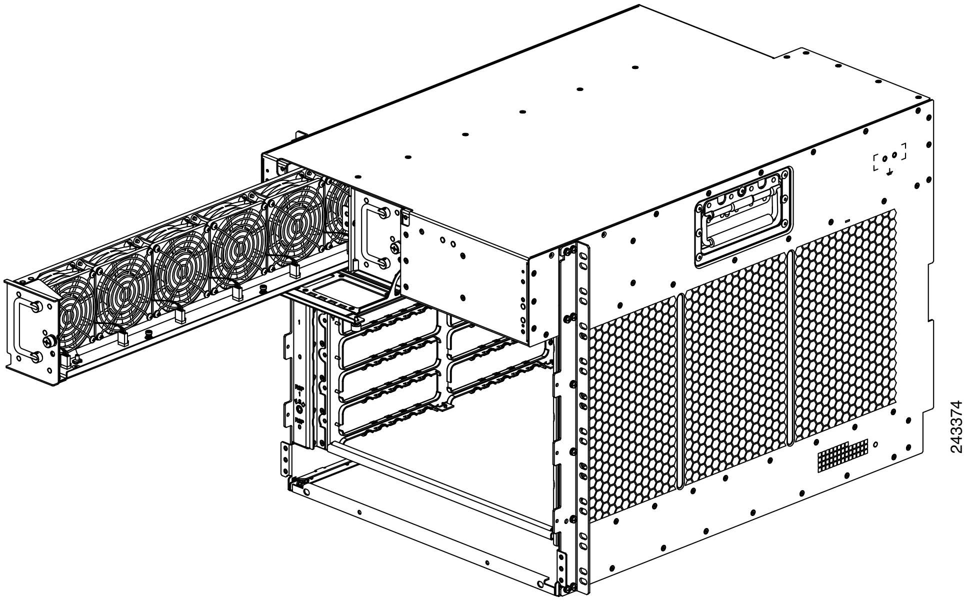
Figure 2-27 ASR 9006 Router Fan Tray



Status Indicators

The ASR 9010 Router fan tray has a Run/Fail status LED on the front panel (see Figure 2-26) to indicate fan tray status.

The ASR 9006 Router fan tray has a Run/Fail status LED on the front panel to indicate fan tray status.

After fan tray insertion into the chassis, the LED lights up temporarily appearing yellow. During normal operation:

- The LED lights green to indicate that all fans in the module are operating normally.
- The LED lights red to indicate a fan failure or another fault in the fan tray module. Possible faults are:
  - A stopped fan
  - Fans running below required speed to maintain sufficient cooling
  - The controller card has a fault

Fan Tray Servicing

No cables or fibers need to be moved during installation or removal of the fan tray(s). Replacing fan trays does not interrupt service.

Slot Fillers

To maintain optimum cooling performance in the chassis and at the slot level, unused slots must be filled with card blanks or flow restrictors. These slot fillers are simple sheet metal only and are not active. Software cannot detect their existence.

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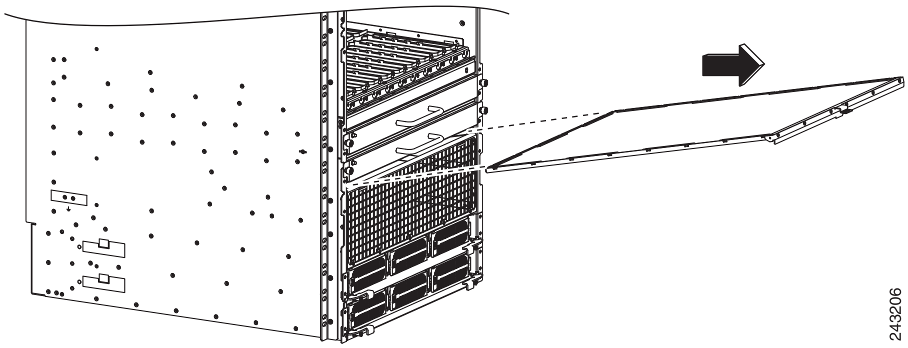
Chassis Air Filter

The chassis air filters in the Cisco ASR 9000 Series Router are NEBS compliant. The filter is not serviceable. but is a field replaceable unit (FRU). Replacing the filter will not interrupt service.

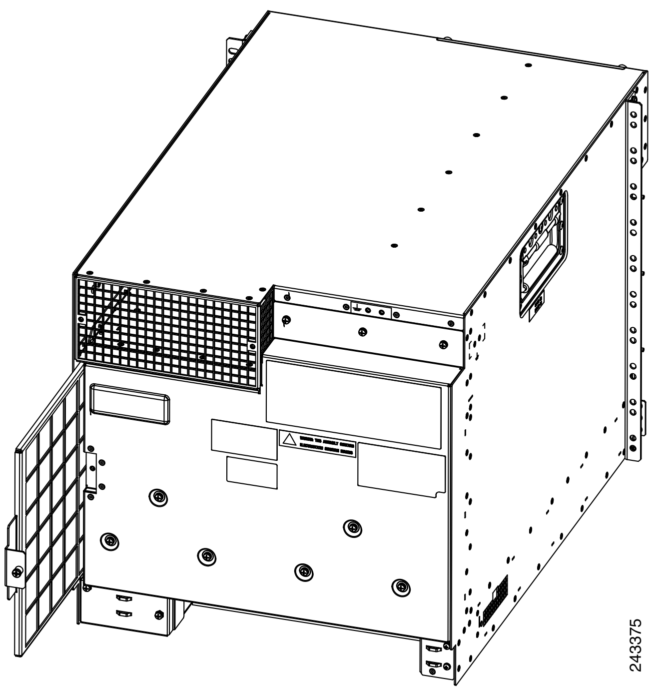
In the ASR 9010 Router, a chassis air filter is located underneath the fan trays (Figure 2-28).

Figure 2-28 ASR 9010 Router Chassis Air Filter



In the ASR 9006 Router, a chassis air filter is located along the right side of the chassis, and is accessible from the rear of the chassis (Figure 2-29).

Figure 2-29 ASR 9006 Router Chassis Air Filter



Speed Control

The cooling system adjusts its speed to compensate for changes in system or external ambient temperatures. To reduce operating noise, the fans have variable speeds. Speed can also vary depending on system configurations that affect total power dissipation. If lower power cards are installed, the system could run at slower speeds; if higher power cards are installed, the system could run at faster speeds

Fan speed is managed by the RSP card and the controller card in the fan tray. The RSP monitors card temperatures and sends a fan speed to the controller card.

If the failure of a single fan within a module is detected, the failure causes an alarm and all the other fans in the fan tray go to full speed.

Complete failure of one fan tray will cause the remaining fan tray to operate its fans at full speed continuously until a replacement fan tray is installed.

Temperature Sensing and Monitoring

Temperature sensors are present on cards to monitor the internal temperatures. Line cards and RSP cards have their leading edge (inlet) and hottest spot continuously monitored by temperature sensors. Some cards have additional sensors located near hot components that need monitoring. Some ASICS have internal diodes that might be used to read junction temperatures.

If the ambient air temperature is within the normal operating range, the fans operate at the lowest speed possible to minimize noise & power consumption.

If the air temperature in the card cage rises, fan speed increases to provide additional cooling air to the internal components. If a fan fails, the others increase in speed to compensate.

Fan tray removal will trigger environmental alarms and will increase the fan speed of the remaining tray to its maximum speed.

Servicing

The system is populated with two fan trays for redundancy. In the event of a fan tray failure condition, it is possible to swap a single fan tray assembly while the system is operational.

Fan tray removal does not require removal of any cables.

Assuming redundant configuration, removal of a fan tray results in zero packet loss.

System Shutdown

When the system reaches critical operating temperature points, it triggers a shutdown sequence of the system.

System Management and Configuration

The Cisco IOS XR Software on the Cisco ASR 9000 Series Router provides the system manageability interfaces: CLI, XML, and SNMP.

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Cisco IOS XR Software

The Cisco ASR 9000 Series Router run Cisco IOS XR Software and use the manageability architecture of that operating system, which includes CLI, SNMP, and XML. Craft Works Interface (CWI), a graphical craft tool for performance monitoring, is embedded with the Cisco IOS XR Software and can be downloaded through the HTTP protocol. However, the Cisco ASR 9000 Series only supports a subset of CWI functionality. In this mode, a user can edit the router configuration file, open Telnet/SSH application windows, and create user-defined applications.

System Management Interfaces

The system management interfaces consist of the CLI, XML, and SNMP protocols. By default, only CLI on the console is enabled. When the management LAN port is configured, various services can be started and used by external clients, such as Telnet, SSH, and SNMP, In addition, TFTP and Syslog clients can interact with external servers. CWI can be downloaded and installed on a PC or Solaris box.

For information about SNMP, see the "SNMP" section on page 2-37.

All system management interfaces have fault and physical inventory.

Command Line Interface

The CLI supports configuration file upload and download through TFTP. The system supports generation of configuration output without any sensitive information such as passwords, keys, etc. The Cisco ASR 9000 Series supports Embedded Fault Manager (TCL scripted policies) through CLI commands. The system also supports feature consistency between the CLI and SNMP management interfaces.

Craft Works Interface

The system supports CWI, a graphical craft tool for performance monitoring, configuration editing, and configuration rollback. CWI is embedded with IOS XR and can be downloaded through the HTTP protocol. A user can use CWI to edit the router configuration file, create user-defined applications, and open Telnet/SSH application windows to provide CLI access.

XML

External (or XML) clients can programmatically access the configuration and operational data of the Cisco ASR 9000 Series Router using XML. The XML support includes retrieval of inventory, interfaces, alarms, and performance data. The system is capable of supporting 15 simultaneous XML/SSH sessions. The system supports alarms and event notifications over XML and also supports bulk PM retrieval and bulk alarms retrieval.

XML clients are provided with the hierarchy and possible contents of the objects that they can include in their XML requests (and can expect in the XML responses), documented in the form of an XML schema.

When the XML agent receives a request, it uses the XML Service Library to parse and process the request. The Library forwards the request to the Management Data API (MDA) Client Library, which retrieves data from the SysDB. The data returned to the XML Service Library is encoded as XML responses. The agent then processes and sends the responses back to the client as response parameter of the invoke method call. The alarm agent uses the same XML Service Library to notify external clients about configuration data changes and alarm conditions.

SNMP

The SNMP interface allows management stations to retrieve data and to get traps. It does not allow setting anything in the system.

SNMP Agent

In conformance with SMIv2 (Structure of Management Information Version 2) as noted in RFC 2580, the system supports SNMPv1, SNMPv2c, and SNMPv3 interfaces. The system supports feature consistency between the CLI and SNMP management interfaces.

The system is capable of supporting at least 10 SNMP trap destinations. Reliable SNMP Trap/Event handling is supported.

For SNMPv1 and SNMPv2c support, the system supports SNMP View to allow inclusion/exclusion of Miss for specific community strings. The SNMP interface allows the SNMP SET operation.

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MIBs

The Device Management MIBs supported by the Cisco ASR 9000 Series Router are listed in Table 2-5.

Table 2-5 Supported Device Management MIBs

SNMP Agent Support	SNMPv1 RFC 1157
	SNMPv2c RFC 1901
	SNMPv3 RFC 3410, RFC 3411, RFC 3412, RFC 3413, RFC 3414, RFC 3415, RFC 3416, RFC 3417
	RFC1213-MIB
Chassis	ENTITY-MIB
	CISCO-ENTITY-ASSET-MIB
	CISCO-ENTITY-FRU-CONTROL-MIB
	CISCO-ENTITY-SENSOR-MIB
	CISCO-CONFIG-MAN-MIB
	CISCO-CONFIG-COPY-MIB
	CISCO-SYSLOG-MIB
Redundancy	CISCO-RF-MIB
Memory	CISCO-MEMORY-POOL-MIB
	CISCO-ENHANCED-MEMORY-POOL-MIB
Flash Disk	CISCO-FLASH-MIB
	CISCO-ENHANCED-IMAGE-MIB
SNMP Related MIBs	EVENT-MIB
	CISCO-BULK-FILE-MIB
	CISCO-FTP-CLIENT-MIB
	SNMP-COMMUNITY-MIB
	SNMP-FRAMEWORK-MIB
	SNMP-NOTIFICATION-MIB
	SNMP-TARGET-MIB
	SNMP-VACM-MIB
Interface Management	IF-MIB

Table 2-5 Supported Device Management MIBs (continued)

Layer 2	ETHERLIKE-MIB DOT3-OAM-MIB IEEE8021-CFM-MIB IEEE8023-LAG-MIB CISCO-IETF-PW-MIB CISCO-IETF-PW-ENET-MIB CISCO-IETF-PW-MPLS-MIB CISCO-IETF-PW-TC-MIB CISCO-VPLS-GENERIC-MIB CISCO-VPLS-LDP-MIB BRIDGE-MIB
QoS	CISCO-CLASS-BASED-QOS-MIB
MPLS:	MPLS-TE-STD-MIB
IP	IP-MIB (RFC-2011) IP-MIB (IPv6, RFC-2496 CISCO-IETF-IPMROUTE-MIB BGP4-MIB CISCO-BGP4-MIB

Online Diagnostics

System run-time diagnostics are used by the Cisco Technical Assistance Center (TAC) and/or the end user to troubleshoot a field problem and assess the state of a given system.

Some examples of the run-time diagnostics include the following:

- Monitoring line card to RSP card communication paths
- Monitoring line card to RSP card data path
- Monitoring CPU communication with various components on the line cards and RSP cards

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CHAPTER 3

High Availability and Redundant Operation

This chapter describes the high availability and redundancy features of the Cisco ASR 9000 Series Aggregation Services Routers.

Features Overview

The Cisco ASR 9000 Series Routers are designed to have high Mean Time Between Failures (MTBF) and low Mean Time To Resolve (MTTR) rates, thus providing a reliable platform that minimizes outages or downtime and maximizes availability.

In addition, the Cisco ASR 9000 Series offers the following high availability (HA) features to enhance network level resiliency and enable network-wide protection:

- High Availability Router Operations
  - Stateful Switchover
  - Fabric Failover
  - Non-Stop Forwarding
  - Process Restartability
  - Fault Detection and Management
- Power Supply Redundancy
- Cooling System Redundancy

High Availability Router Operations

The Cisco ASR 9000 Series offers a variety of hardware and software high availability features.

Stateful Switchover

The Route Switch Processor (RSP) cards are deployed in "active/standby" configurations. Stateful switchover (SSO) preserves state and configuration information in the event of a switchover to the standby RSP card. The standby RSP card has a mirror image of the state of protocols, users configuration, interface state, subscriber state, system state and other parameters. Should a hardware or software failure occur in the active RSP card, the standby RSP card changes state to become the active RSP card. This stateful switchover has no impact in forwarding traffic.

Fabric Failover

The RSP card makes up most of the fabric. The fabric is configured in an "active/active" configuration model which allows the traffic load to be distributed across both RSP cards. In the case of a failure, the single "active" switch fabric will continue to forward traffic in the systems.

Active/Standby Status Interpretation

Status signals from each RSP card are monitored to determine active/standby status and if a failure has occurred that requires a switchover from one RSP card to the other.

Non-Stop Forwarding

Cisco IOS XR Software supports non-stop forwarding (NSF) to enable the forwarding of packets without traffic loss during a brief outage of the control plane. NSF is implemented through signaling and routing protocol implementations for graceful restart extensions as standardized by the Internet Engineering Task Force (IETF).

For example, a soft reboot of certain software modules does not hinder network processors, the switch fabric, or the physical interface operation of forwarding packets. Similarly, a soft reset of a non-data path device (such as a Ethernet Out-of-Band Channel Gigabit Ethernet switch) does not impact the forwarding of packets.

Nonstop Routing

Nonstop routing (NSR) allows forwarding of data packets to continue along known routes while the routing protocol information is being refreshed following a processor switchover. NSR maintains protocol sessions and state information across SSO functions for services such as MPLS VPN. TCP connections and the routing protocol sessions are migrated from the active RSP card to the standby RSP card after the RSP failover without letting peers know about the failover. The sessions terminate and the protocols running on the standby RSP card reestablish the sessions after the standby RSP goes active. NSR can also be used with graceful restart to protect the routing control plane during switchovers.

Graceful Restart

Graceful restart (GR) provides a control plane mechanism to ensure high availability by allowing detection and recovery from failure conditions while preserving Nonstop Forwarding (NSF) services. Graceful restart is a way to recover from signaling and control plane failures without impacting the forwarding plane. Cisco IOS XR Software uses graceful restart and a combination of check pointing, mirroring, route switch processor redundancy, and other system resiliency features to recover prior to timeout and avoid service downtime as a result of network reconvergence.

Process Restartability

The Cisco IOS XR distributed and modular microkernel operating system enables process independence, restartability, and maintenance of memory and operational states. Each process runs in a protected address space. Checkpointing facilities, reliable transports and retransmission features enable processes to be restarted without impacting other components and with minimal or no disruption of traffic. Usually any time a process fails, crashes or incurs any faults, the process restarts itself. For example, if a Border Gateway Protocol (BGP) or Quality of Service (QoS) process incurs a fault, it restarts to resume its normal routine without impacting other processes.

Fault Detection and Management

The Cisco ASR 9000 Series provides rapid and efficient response to single or multiple system component or network failures to minimize service outage. When local fault handling cannot recover from critical faults, the system offers robust fault detection, correction, failover, and event management capabilities.

- Fault detection and correction - In hardware, the ASR 9000 offers error correcting code (ECC)-protected memory. If a memory corruption occurs, the system automatically restarts the impacted processes to fix the problem with minimum impact. If the problem is persistent, the ASR 9000 supports switchover and online insertion and removal (OIR) capabilities to allow replacement of defective hardware without impacting services on other hardware components in the system.
- Resource management - As part of its fault-handling capabilities, the ASR 9000 supports resource threshold monitoring for CPU and memory utilization to improve out of resource (OOR) management. When threshold conditions are met or exceeded, the system generates an OOR alarm to notify operators of OOR conditions. The system then automatically attempts recovery, and allows the operator to configure flexible policies using the embedded event manager.
- Online diagnostics - the Cisco ASR 9000 Series provides built-in online diagnostics to monitor functions such as network path failure detection, packet diversion failures, faulty fabric link detections, etc. The tests are configurable through the CLI.
- Event management - The Cisco ASR 9000 Series offers mechanisms such as fault-injection testing to detect hardware faults during lab testing, a system watchdog mechanism to recover failed processes, and tools such as the Route Consistency Checker to diagnose inconsistencies between the routing and forwarding tables.

Power Supply Redundancy

The Cisco ASR 9000 Series Routers are configured in such a way that a power module failure or its subsequent replacement does not cause a significant outage.

A power supply failure or over/under voltage at the output of the power supply is detected and an alarm raised.

AC Power Redundancy

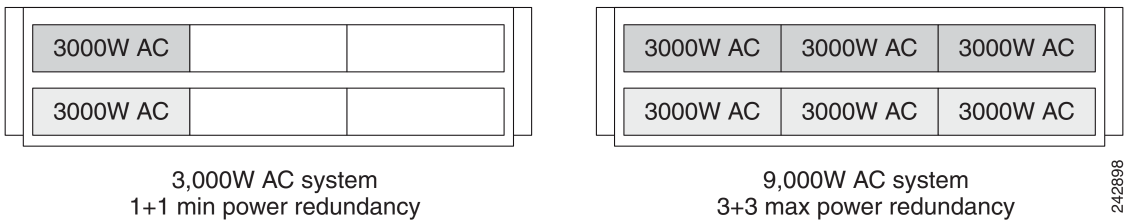
The AC power modules are a modular design allowing replacement without any outage. Each shelf houses up to three power modules. Minimum and maximum module configurations are shown in Figure 3-1. At least one fully loaded AC shelf is required to power a fully loaded system. Each module outputs 3000 W.

Note AC power redundancy for the Cisco ASR 9010 Router requires two power shelves.

For Cisco ASR 9010 Routers, the slot location of a module in the shelf is irrelevant as long as the redundant power shelf has an equal number of modules.

For Cisco ASR 9006 Routers, the slot location of a module in the shelf is irrelevant as long as there are N+1 number of modules.

Figure 3-1 AC System Power Redundancy



Note The Cisco ASR 9010 Router is capable of operating with one power shelf. However, such a configuration does not provide any redundancy.

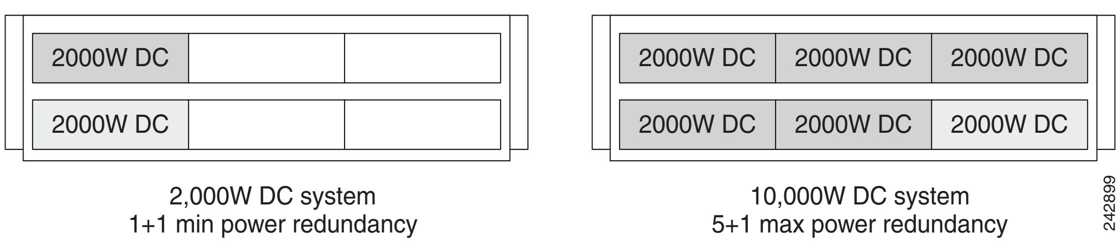
DC Power Redundancy

The DC power modules are a modular design allowing replacement without any outage. Each shelf can house up to three power modules. Minimum and maximum module configurations are shown in Figure 3-2. Each module will output 2100 W.

Note For the Cisco ASR 9010 Router, DC power redundancy requires two power shelves

The slot location of a module in the shelf is irrelevant as long as there are N+1 number of modules.

Figure 3-2 DC System Power Redundancy



Note The Cisco ASR 9000 Series Routers are capable of operating with one power module. However, such a configuration does not provide any redundancy.

Redundant –48 VDC power feeds are separately routed to each power shelf. For maximum diversity, the power entry point to each shelf is spatially separated to the left and right edges of the shelf. Each feed can support the power consumed by the entire shelf. There is no load sharing between the feeds. Each power module in the shelf uses either feed for power, enabling maintenance or replacement of a power feed without causing interruption.

Detection and Reporting of Power Problems

All –48 VDC feed and return lines have fuses and are monitored. Any fuse blown can be detected and reported. The input voltages are monitored against an over and under voltage alarm threshold. The controller area network (CAN) monitors the power output voltage levels.

Cooling System Redundancy

The Cisco ASR 9000 Series Routers are configured in such a way that a fan failure or its subsequent replacement does not cause a significant outage. During either a fan replacement or a fan failure, the airflow is maintained and no outage occurs. Also, the fan trays are hot swappable so that no outage occurs during replacement.

The Cisco ASR 9010 Router has two fan trays at the bottom of the card shelf. Each fan tray has 12 fans arranged in three groups of four fans each. Two fans of each group share a fan controller. The power supplied to the fan controller is 1:3 protected. A single fan failure has no impact on air flow because the other 11 fans will compensate for it. If the fan controller fails, there is a possibility of up to two fans failing, however, the design will always have two fans operating in a row (three rows of fans) to compensate for the air speed.

The Cisco ASR 9006 Router has two fan trays at the top left of the chassis. Each fan tray has six fans arranged in three groups of two fans each. The two fans in a group share a fan controller. The power supplied to the fan controller is 1:3 protected. A single fan failure has no impact on air flow because the other five fans will compensate for it. If the fan controller fails, there is a possibility of up to two fans failing, however, the design will always have two fans operating to compensate for the air speed.

Caution If only one fan tray is installed in the system, one single point of failure will not cause all fans to stop. However, the system cannot operate without a fan tray. The system shuts itself off if all fan trays are removed.

Cooling Failure Alarm

Temperature sensors are installed in all cards and fan trays. These sensors detect and report any fan failure or high temperature condition, and raise an alarm. Fan failure can be a fan stopping, fan controller failure, power failure, or a failure of a communication link to the RSP card.

Every card has temperature measurement points in the hottest expected area to clearly indicate a cooling failure. The line cards have two sensors, one at the inlet and one near the hottest devices on the card. The RSP card also has two sensors.

APPENDIX A

Technical Specifications

This appendix lists the specifications for the Cisco ASR 9000 Aggregation Services Router.

The specifications are presented in the following tables:

- Table A-1, "ASR 9010 Router Physical Specifications"
- Table A-2, "ASR 9006 Router Physical Specifications"
- Table A-3, "ASR 9010 AC Electrical Specifications"
- Table A-4, "ASR 9006 AC Electrical Specifications"
- Table A-5, "ASR 9010 DC Electrical Specifications"
- Table A-6, "ASR 9006 DC Electrical Specifications"
- Table A-7, "AC Input Voltage Range"
- Table A-8, "DC Input Voltage Range"
- Table A-9, "DC Output Levels"
- Table A-10, "Cisco ASR 9000 Series Environmental Specifications"
- Table A-11, "RSP Port Specifications"

Table A-1 lists the physical specifications for the Cicso ASR 9010 Router.

Table A-1 ASR 9010 Router Physical Specifications

Description	Value
Chassis height	36.75 in. (93.35 cm)
Chassis width	17.50 in. (44.45 cm) 19.0 in. (48.3 cm) including chassis rack-mount flanges and front door width
Chassis depth	22.0 in. (55.9 cm) 28.65 in (72.72 cm) including cable management system and front cover
Chassis weight	
• Chassis only[1]	149.5 pounds (67.81 kg)
• Chassis: fully configured using all card slots and six power modules	375 pounds (170.5 kg)

1. Chassis only does not include cards, power modules, fan trays, filter or chassis accessories.

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Table A-2 lists the physical specifications for the Cisco ASR 9006 Router.

Table A-2 ASR 9006 Router Physical Specifications

Description	Value
Chassis height	17.50 in. (44.45 cm)
Chassis width	17.50 in. (44.45 cm) 19.0 in. (48.3 cm) including chassis rack-mount flanges and front door width
Chassis depth	22.0 in. (55.9 cm) 28.65 in (72.72 cm) including cable management system and front cover
Chassis weight	
• Chassis only[1]	87.5 pounds (39.69 kg)
• Chassis: fully configured using all card slots and three power modules	230 pounds (104.33 kg)

1. Chassis only does not include cards, power modules, fan trays, filter or chassis accessories.

Table A-3 lists the AC electrical specifications for the Cicso ASR 9010 Router

Table A-3 ASR 9010 AC Electrical Specifications

Description	Value
Total AC input power	3000 VA (volt-amps) per AC power supply (up to 6 AC power supply modules per system)
Rated input voltage[1]	200–240 VAC nominal (range: 180 to 264 VAC) 220–240 VAC (UK)
Rated input line frequency[1]	50/60 Hz nominal (range: 47 to 63 Hz) 50/60 Hz (UK)
Input current rating[1]	15 A maximum at 200 VAC 13 A maximum at 220 to 240 VRMS (UK)
Source AC service requirement[1]	20 A North America; 16 A international; 13 A UK
Redundancy	At least four AC power supply modules (two per power shelf) are required for 2N redundancy for a fully-configured system.

1. For each AC power supply module.

Caution Be sure that the chassis configuration complies with the required power budgets. Failure to properly verify the configuration may result in an unpredictable state if one of the power units fails. Contact your local sales representative for assistance.

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Table A-4 lists the AC electrical specifications for the Cisco ASR 9006 Router.

Table A-4 ASR 9006 AC Electrical Specifications

Description	Value
Total AC input power	3000 VA (volt-amps) per AC power supply (up to 3 AC power supply modules per system)
Rated input voltage[1]	200–240 VAC nominal (range: 180 to 264 VAC) 220–240 VAC (UK)
Rated input line frequency[1]	50/60 Hz nominal (range: 47 to 63 Hz) 50/60 Hz (UK)
Input current rating[1]	15 A maximum at 200 VAC 13 A maximum at 220 to 240 VRMS (UK)
Source AC service requirement[1]	20 A North America; 16 A international; 13 A UK
Redundancy	At least three AC power supply modules are required for N+1 redundancy for a fully-configured system.

1. For each AC power supply module.

Table A-5 lists the DC electrical specifications for the Cicso ASR 9010 Router.

Table A-5 ASR 9010 DC Electrical Specifications

Description	Value
Total DC Input Power	2100 W per DC power supply module (up to 6 DC power supply modules per system)
Rated input voltage[1]	–48 VDC nominal in North America –60 VDC nominal in the European Community (range: –40.5 to –72 VDC (–75 VDC for 5 ms))
Input current rating[1]	41 A maximum with single input to each module, with five modules in the system providing maximum system power of 7360 W of –54 VDC output power.
Source DC service requirement[1]	Sufficient to supply the rated input current. Local codes apply.
Redundancy	At least three DC power supply modules (in either power shelf) are required for N+1 redundancy for a fully-configured system.

1. For each DC power module.

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Table A-6 lists the DC electrical specifications for the Cisco ASR 9006 Router.

Table A-6 ASR 9006 DC Electrical Specifications

Description	Value
Total DC Input Power	2100 W per DC power supply module (up to 6 DC power supply modules per system)
Rated input voltage[1]	–48 VDC nominal in North America –60 VDC nominal in the European Community (range: –40.5 to –72 VDC (–75 VDC for 5 ms))
Input current rating[1]	41 A maximum with single input to each module, with three modules in the system providing maximum system power of 7360 W of –54 VDC output power.
Source DC service requirement[1]	Sufficient to supply the rated input current. Local codes apply.
Redundancy	At least three DC power supply modules are required for N+1 redundancy for a fully-configured system.

1. For each DC power module.

Table A-7 lists the AC input voltage range for the AC-powered Cisco ASR 9000 Series Routers (single phase power source).

Table A-7 AC Input Voltage Range

Range	Minimum	Minimum Nominal	Nominal	Maximum Nominal	Maximum
Input Voltage	180 VAC	200 VAC	220 VAC	240 VAC	264 VAC
Line Frequency	47 Hz	50 Hz	50/60 Hz	60 Hz	63 Hz

Table A-8 lists the DC input voltage range for the DC-powered Cisco ASR 9000 Series Routers.

Table A-8 DC Input Voltage Range

Range	Minimum	Nominal	Maximum
Input Voltage	400 VDC	48 VDC	72 VDC

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Table A-9 lists the DC output tolerances for either AC or DC power modules.

Table A-9 DC Output Levels

Parameter	Value
Voltage	
Maximum	–54.5 VDC
Nominal	–54.0 VDC
Minimum	–53.5 VDC
Power	
Minimum (one module per shelf)	3000 W
Maximum (three modules per shelf)	9000 W

Table A-10 lists the environmental specifications for the Cisco ASR 9000 Series Routers.

Table A-10 Cisco ASR 9000 Series Environmental Specifications

Description	Value
Operating Temperature[1]:	
ASR 9010 (all racks)	23 degrees to 131 degrees F (–5 degrees to 55 degrees C)
ASR 9006	
2-post 23-in rack 2-post 19-in rack with vents 4-post rack[2]	23 degrees to 131 degrees F (–5 degrees to 55 degrees C)
2-post 19-in rack (no vents)	23 degrees to 122 degrees F (–5 degrees to 50 degrees C)
Nonoperating Temperature (ASR 9010, ASR 9006)	–4 degrees to 149 degrees F (–20 degrees to 65 degrees C)
Humidity	Operating: 10 to 85 percent noncondensing Nonoperating: 5 to 95 percent noncondensing
Altitude	Operating: 0 to 13,000 ft (0 to 4,000 m) Nonoperating: 0 to 15,000 ft (0 to 4,570 m)
Acoustic noise	78 dB at 80.6 degrees F (27 degrees C) maximum
Shock	Operating (halfsine): 21 in/sec (0.53 m/sec) Nonoperating (trapezoidal pulse): 20 G[3], 52 in/sec (1.32 m/sec)
Vibration	Operating: 0.35 Grms[4] from 3 to 500 Hz Nonoperating: 1.0 Grms from 3 to 500 Hz

1. Operating temperature specifications for the router will differ from those listed in this table when 40-port Gigabit Ethernet line cards using GLC-GE-100FX SFP transceiver modules are installed in the router. This is due to the lower temperature specifications of the SFP module. Please contact a Cisco representative for more information.
2. 4-post rack with front and rear doors and right side panel removed or with 65% (minimum) perforated area .
3. G is a value of acceleration, where 1G equals 32.17 ft/sec^2 (9.81 m/sec^2).
4. Grms is the root mean square value of acceleration.

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Table A-11 lists the RSP port specifications.

Table A-11 RSP Port Specifications

Description	Value
Console port	RS232 DCE interface, 9600 Baud, 8 data, no parity, 1 stop bit with software handshake (default).
Auxiliary port	RS232 DCE interface, 9600 Baud, 8 data, no parity, 1 stop bit with software handshake (default).
Management ports (0, 1)	Triple-speed (10M/100M/1000M) RJ-45
Sync ports (0, 1)	Can be configured as one of the following: • BITS (Building Integrated Timing System) port • J.211 or UTI (Universal Timing Interface) port

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