Cisco ASR 9000 Series Aggregation Services Router Overview and Reference Guide

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Cisco ASR 9000 Series Aggregation Services Router Overview and Reference Guide
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Preface

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

Audience

This guide is written for hardware installers and system administrators of Cisco routers.

This publication assumes that the reader 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.

Related Documentation

For more information on the Cisco ASR 9000 Series Aggregation Services Router, additional documents found at:

http://www.cisco.com/en/US/products/ps9853/prod_installation_guides_list.html

Changes to This Document

Table 1 lists the technical changes made to this document since it was first created.

Table 1 Changes to This Document

Revision	Date	Change Summary
OL-17501-09	September 2013	Information added about the Cisco ASR 9904 Aggregation Services Router.
OL-17501-08	July 2013	Information added about the Cisco ASR 9912 Aggregation Services Router.
OL-17501-07	May 2013	Information added about the new 8-port 10-GE Modular Port Adapter (MPA).
OL-17501-06	September 2012	Information added about the new Cisco ASR 9922 Router, RP card, FC card, and the new 1-port 40-GE Modular Port Adapter (MPA), the new 36-Port 10-Gigabit Ethernet Line Card and the new 1-Port 100-Gigabit Ethernet Line Card.
OL-17501-05	March 2012	Information about the two types of image files, -P PIE files, and x86-based -PX PIE files added to the Functional Description chapter.
OL-17501-04	December 2011	Information added about the new RSP-440 card, 24-port 10-GE fixed line card, 2-port 100-GE fixed line card, and the modular line card supporting the 20-port GE Modular Port Adapter (MPA), 4-port 10-GE MPA, and 2-port 10-GE MPA. Information added about the new version 2 power system. The Cisco ASR 9006 Router and Cisco ASR 9010 Router now support both version 1 and version 2 power systems.
OL-17501-03	May 2010	Information added about the new 16x10-GE SFP+ line card and additional versions of existing cards.
OL-17501-02	December 2009	Information added about new 8x10GE 80-Gbps line rate card and 2x10GE + 20x1GE combination line card.
OL-17501-01	March 2009	Initial release of this document.

Document Conventions

This publication uses the following conventions:

- **Ctrl** represents the key labeled *Control*. For example, the key combination **Ctrl-Z** means hold down the **Control** 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 enter at the prompt. For example:

  RP/0/RSP0/CPU0:router#

- 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 Additional Information and Support

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

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Overview and Physical Description

This chapter provides an overview of the Cisco ASR 9000 Series Aggregation Services Routers and description of the system components.

Chassis Physical Overview

The Cisco ASR 9000 Series Routers are next-generation edge access routers optimized for service provider applications, designed to fulfill various 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 consists of seven routers:

- Cisco ASR 9001 Router
- Cisco ASR 9001-S Router
- Cisco ASR 9010 Router
- Cisco ASR 9006 Router
- Cisco ASR 9904 Router
- Cisco ASR 9922 Router
- Cisco ASR 9912 Router

This chapter briefly describes the chassis configuration and components of the Cisco ASR 9000 Series Routers. For information on the Cisco ASR 9001 and Cisco ASR 9001-S Routers, see:

Cisco ASR 9001 and Cisco ASR 9001-S Routers Hardware Installation Guide

Cisco ASR 9010 Router

The Cisco ASR 9010 Router chassis is centered around a redundant pair of RSP cards, along with eight line cards. The 10-slot chassis size fits in Telco, EIA, and ETSI racks and cabinets.

The version 1 power system has three power modules in each of two power trays. The version 2 power system has four power modules in each of two power trays.

Figure 1-1 shows the slot locations for the chassis with version 1 power trays.

Figure 1-2 shows the slot locations for the chassis with version 2 power trays.

Figure 1-1 Cisco ASR 9010 Router Chassis Components—Version 1 Power Trays

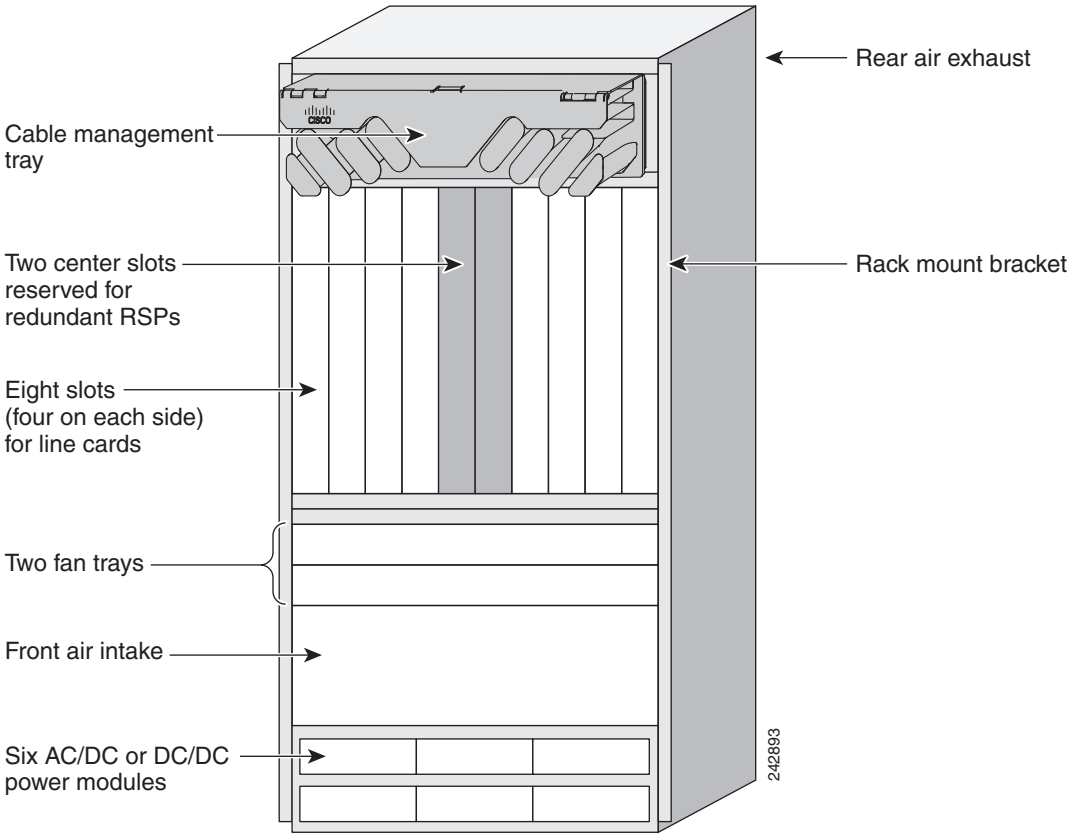
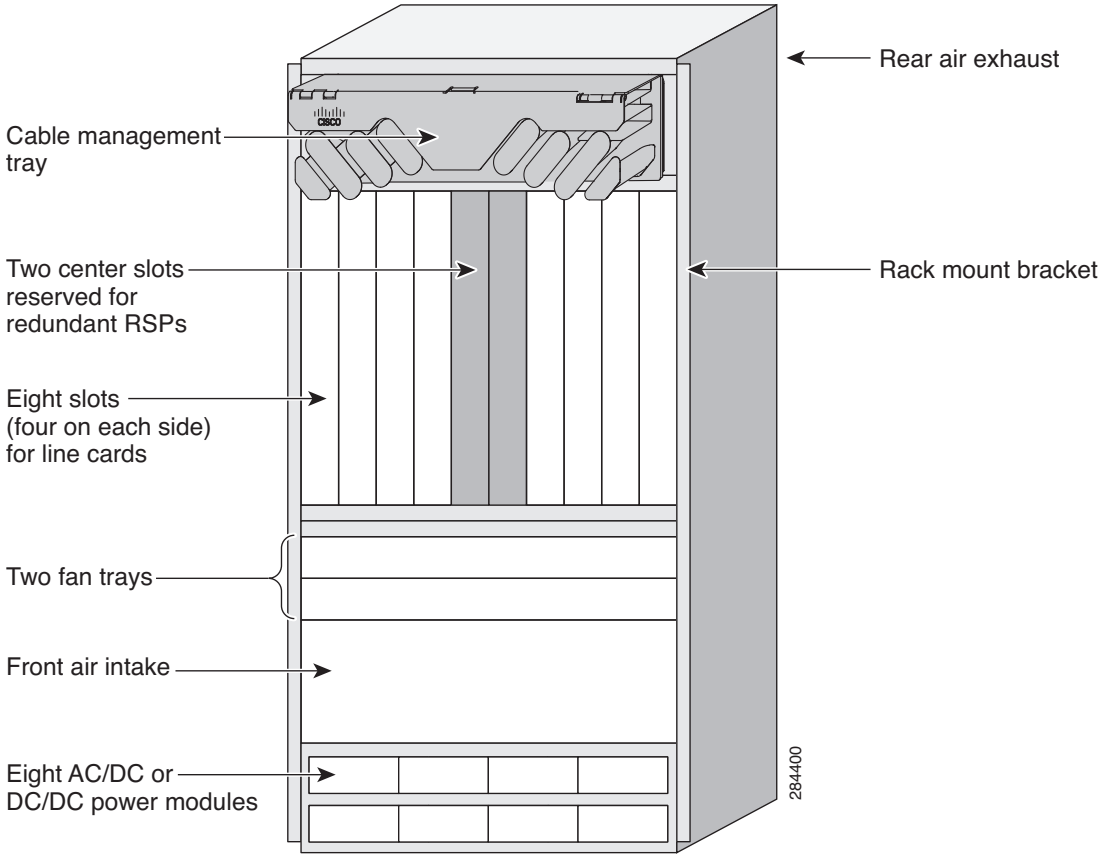


Figure 1-2 Cisco ASR 9010 Router Chassis Components—Version 2 Power Trays



Cisco ASR 9006 Router

The Cisco ASR 9006 Router chassis is centered around a redundant pair of RSP cards, along with four line cards. The 6-slot chassis size fits in Telco, EIA, and ETSI racks and cabinets.

The version 1 power system has three power modules in the single power tray. The version 2 power system has four power modules in the single power tray.

Figure 1-3 shows the slot locations for the chassis with a version1 power tray.

Figure 1-4 shows the slot locations for the chassis with a version 2 power tray.

Figure 1-3 Cisco ASR 9006 Router Chassis Components—Version 1 Power Tray

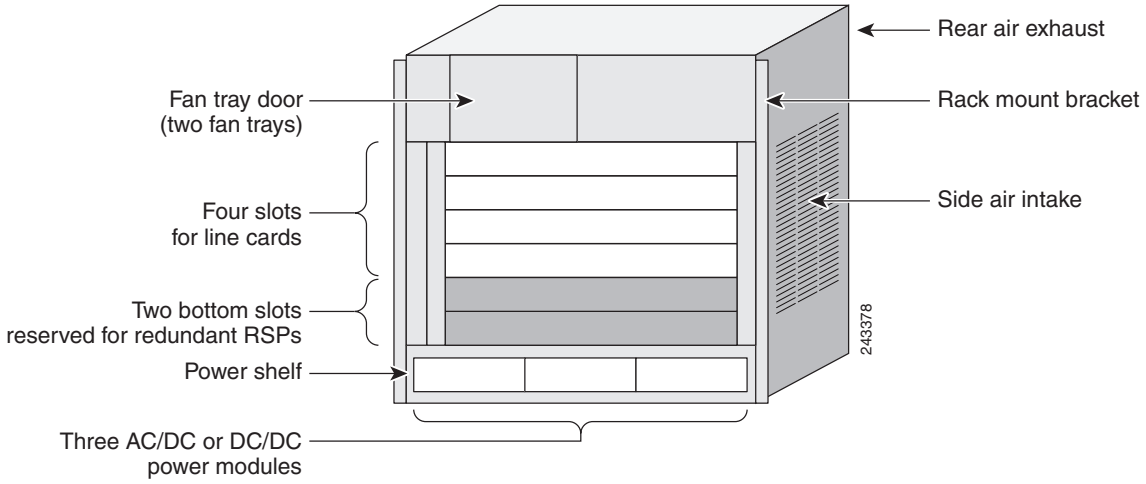
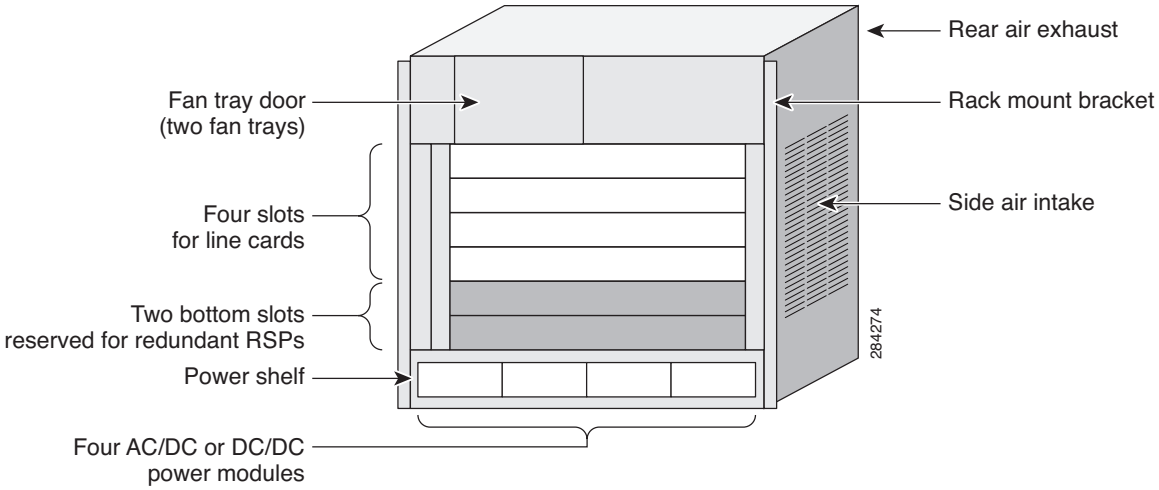


Figure 1-4 Cisco ASR 9006 Router Chassis Components—Version 2 Power Tray



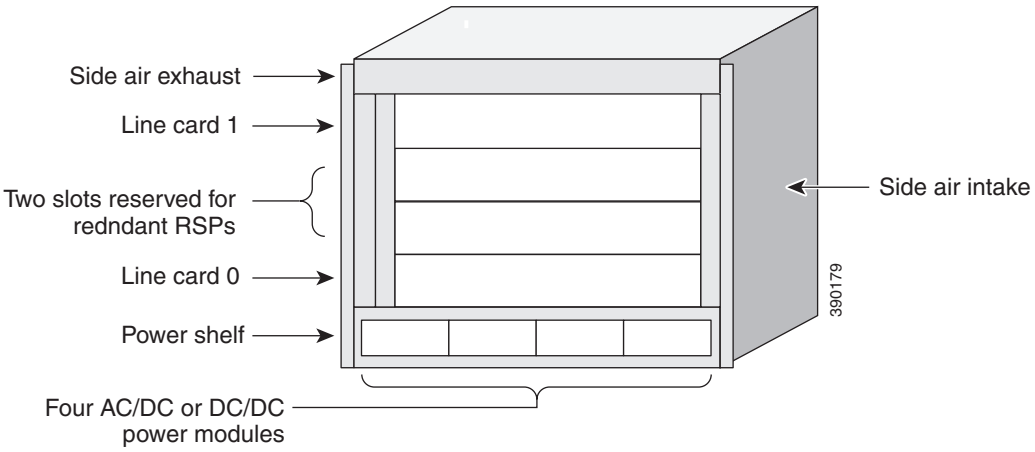
Cisco ASR 9904 Router

The Cisco ASR 9904 Router chassis is centered around a redundant pair of RSP cards, along with two line cards. The 4-slot chassis size fits in Telco, EIA, and ETSI racks and cabinets.

The router supports the version 2 power system that has four power modules in the single power tray.

Figure 1-5 shows the slot locations for the chassis with a version 2 power tray.

Figure 1-5 Cisco ASR 9904 Router Chassis Components—Version 2 Power Tray



Cisco ASR 9922 Router

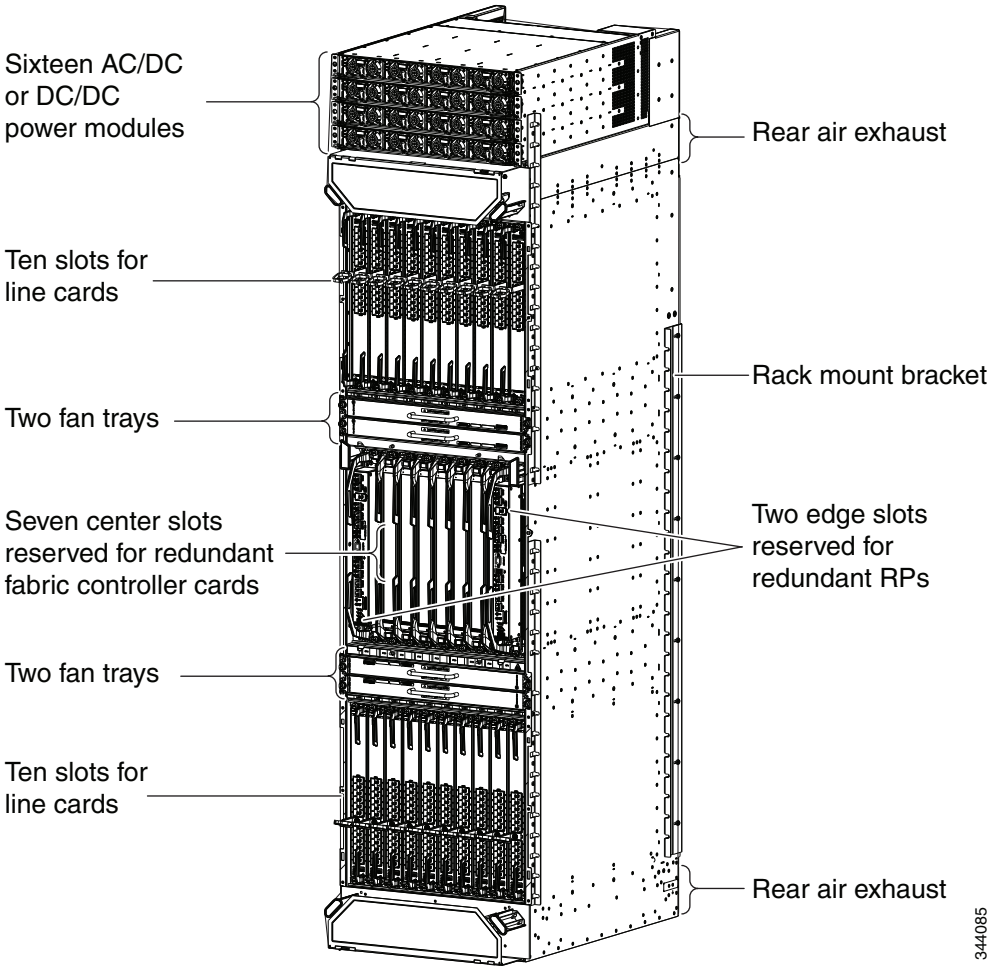
The Cisco ASR 9922 Router chassis is centered around a redundant pair of RP cards, seven redundant FC cards, and twenty line cards. The 22-slot chassis size fits in Telco, EIA, and ETSI racks and cabinets.

The Cisco ASR 9922 Router chassis has two backplanes connected via up to seven FC cards and two RP cards. The upper backplane connects to its one backplane identification (BPID) card, ten line cards, two fan trays, and four power trays. The lower backplane connects to its BPID card, ten line cards, and two fan trays.

The version 2 power system has four power modules in each of four power trays.

Figure 1-6 shows the slot locations for the chassis.

Figure 1-6 Cisco ASR 9922 Router Chassis Components

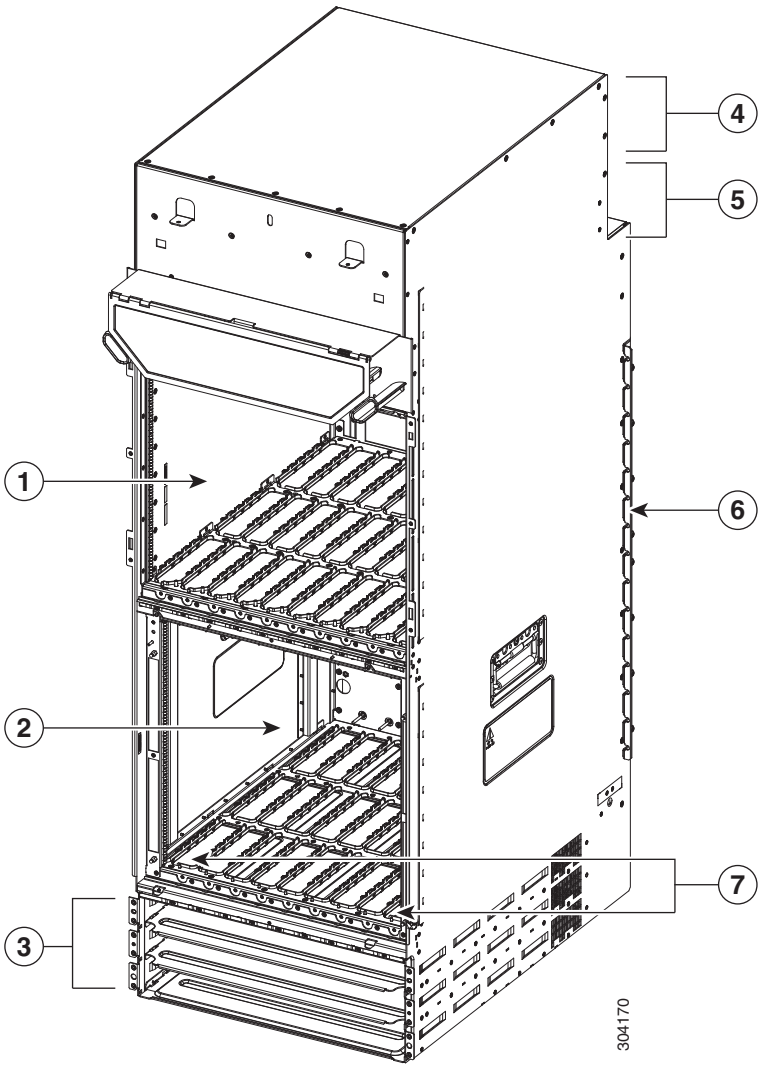


Cisco ASR 9912 Router

The Cisco ASR 9912 Router chassis is centered around a redundant pair of RP cards, seven redundant FC cards, and ten line cards. The chassis fits in Telco, EIA, and ETSI racks and cabinets.

Figure 1-7 shows the slot locations for the chassis.

Figure 1-7 Cisco ASR 9912 Router Chassis Components



1	Ten slots for line cards	**5**	Two fan trays (rear insertion)
2	Seven center slots for FC cards	**6**	Rack mount bracket
3	Three bays for power trays	**7**	Two edge slots for RP cards
4	Rear air exhaust		

Field Replaceable Units

In the Cisco ASR 9010 Router, Cisco ASR 9006 Router, and Cisco ASR 9904 Router, the following components are field replaceable units (FRUs):

- All line cards
- RSP cards
- Power modules
- Power trays
  - Only version 2 power trays are FRUs.
  - Router must be powered down before power tray removal.
- Fan trays
- Air filters
- Line card and RSP blank fillers
- Compact flash disk
- Gigabit Ethernet small form-factor pluggable (SFP) transceiver modules
- 10-Gigabit Ethernet small form-factor pluggable (SFP+) transceiver modules
- 10-Gigabit Ethernet small form-factor pluggable (XFP) transceiver modules
- Optional card cage doors (Cisco ASR 9010 Router only)

Note The backplane, BPID, and version 1 power trays are not FRUs.

In the Cisco ASR 9922 Router and the Cisco ASR 9912 Router, the following components are FRUs:

- All line cards
- RP cards
- FC cards
- Power modules
- Power trays
  - These routers use only version 2 power trays.
  - These routers must be powered down before power tray removal.
- Fan trays and covers
- Air filters and foam media
- Line card and RP blank fillers
- Gigabit Ethernet small form-factor pluggable (SFP) transceiver modules
- 10-Gigabit Ethernet small form-factor pluggable (SFP+) transceiver modules
- 100-Gigabit Ethernet small form-factor pluggable (CFP) transceiver modules
- Optional card cage doors

Note The backplanes and BPID cards are not FRUs.

Rack-Mounting Considerations

The chassis width of the 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
- Telco racks with a rail-to-rail dimension of 17.75 inches (45.09 cm) for the Cisco ASR 9006 Router
- Telco racks with a rail-to-rail dimension of 17.75 inches (45.09 cm) for the Cisco ASR 9904 Router
- Telco racks with a rail-to-rail dimension of 17.75 inches (45.09 cm) for the Cisco ASR 9922 Router
- Telco racks with a rail-to-rail dimension of 17.75 inches (45.09 cm) for the Cisco ASR 9912 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/tray mounting option.Two chassis fit into a commonly used 42 RU rack, and therefore will fit into an ETSI 45 RU 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/tray mounting option. Four chassis fit into a commonly used 42 RU rack, and therefore will fit into an ETSI 45 RU rack with a height of 78.74 inches (200.00 cm).

The Cisco ASR 9904 Router chassis height is 10.38 inches (26.36 cm) or 6 RU (rack units), which includes a rack/tray mounting option. Seven chassis fit into a commonly used 42 RU rack, and therefore will fit into an ETSI 45 RU rack with a height of 78.74 inches (200.00 cm).

The Cisco ASR 9922 Router chassis height is 77.00 inches (195.58 cm) or 44 RU (rack units). The rail mounting option height is 1.00 inch. The Cisco ASR 9922 Router chassis will fit into an ETSI 45 RU rack with a height of 78.74 inches (200.00 cm).

The Cisco ASR 9912 Router chassis height is 52.50 inches (133.35 cm) or 30 RU (rack units). The rail mounting option height is 1.00 inch. The Cisco ASR 9912 Router chassis will fit into an ETSI 45 RU rack with a height of 78.74 inches (200.00 cm).

The chassis depth for these five 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 require adjustable front rails if the rack/cabinet doors must be able to close with the chassis installed.

Figure 1-8 shows the top-down view dimensions of the Cisco ASR 9010 Router.

Figure 1-9 shows the top-down view dimensions of the Cisco ASR 9006 Router.

Figure 1-10 shows the top-down view dimensions of the Cisco ASR 9904 Router.

Figure 1-11 shows the top-down view dimensions of the Cisco ASR 9922 Router.

Figure 1-12 shows the top-down view dimensions of the Cisco ASR 9912 Router.

Figure 1-8 Cisco ASR 9010 Router Chassis Footprint Dimensions—Top Down View

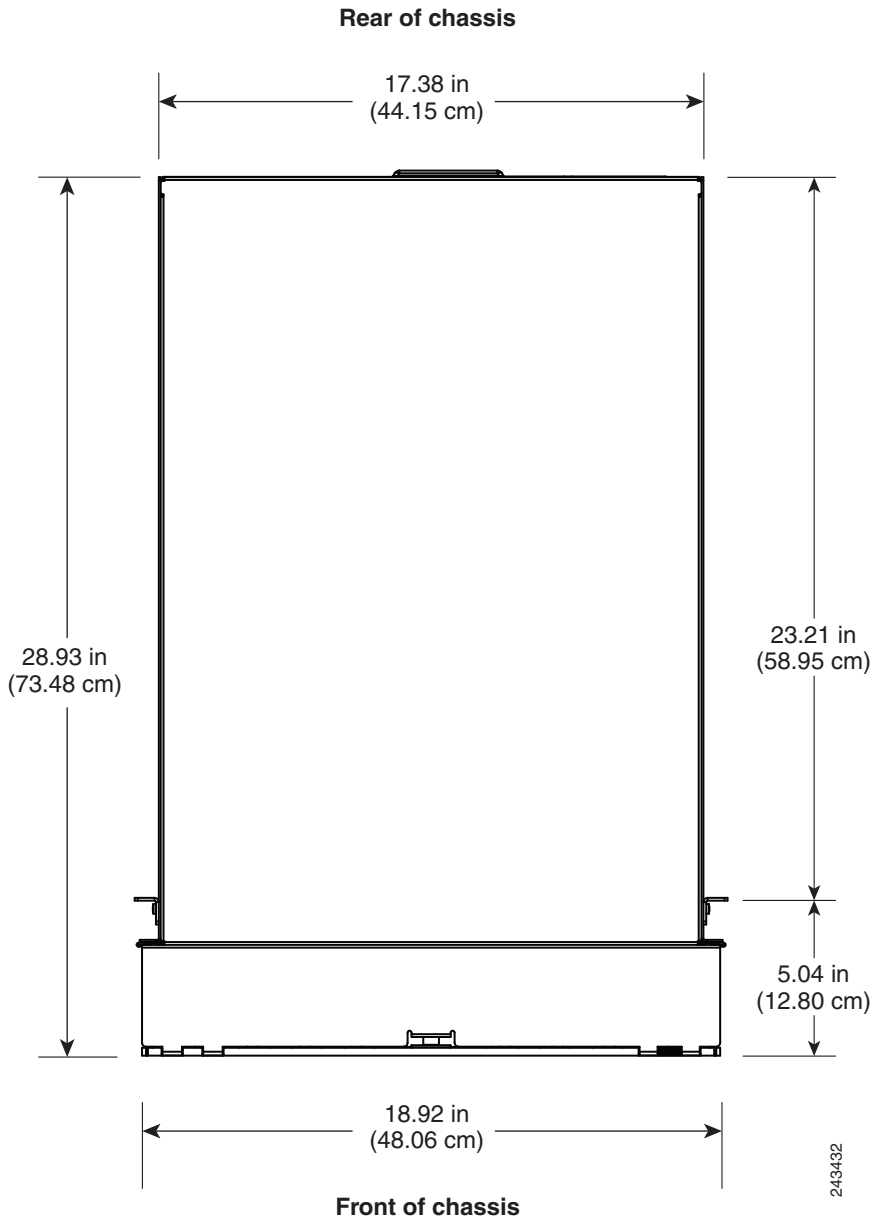


Figure 1-9 Cisco ASR 9006 Router Chassis Footprint Dimensions—Top Down View

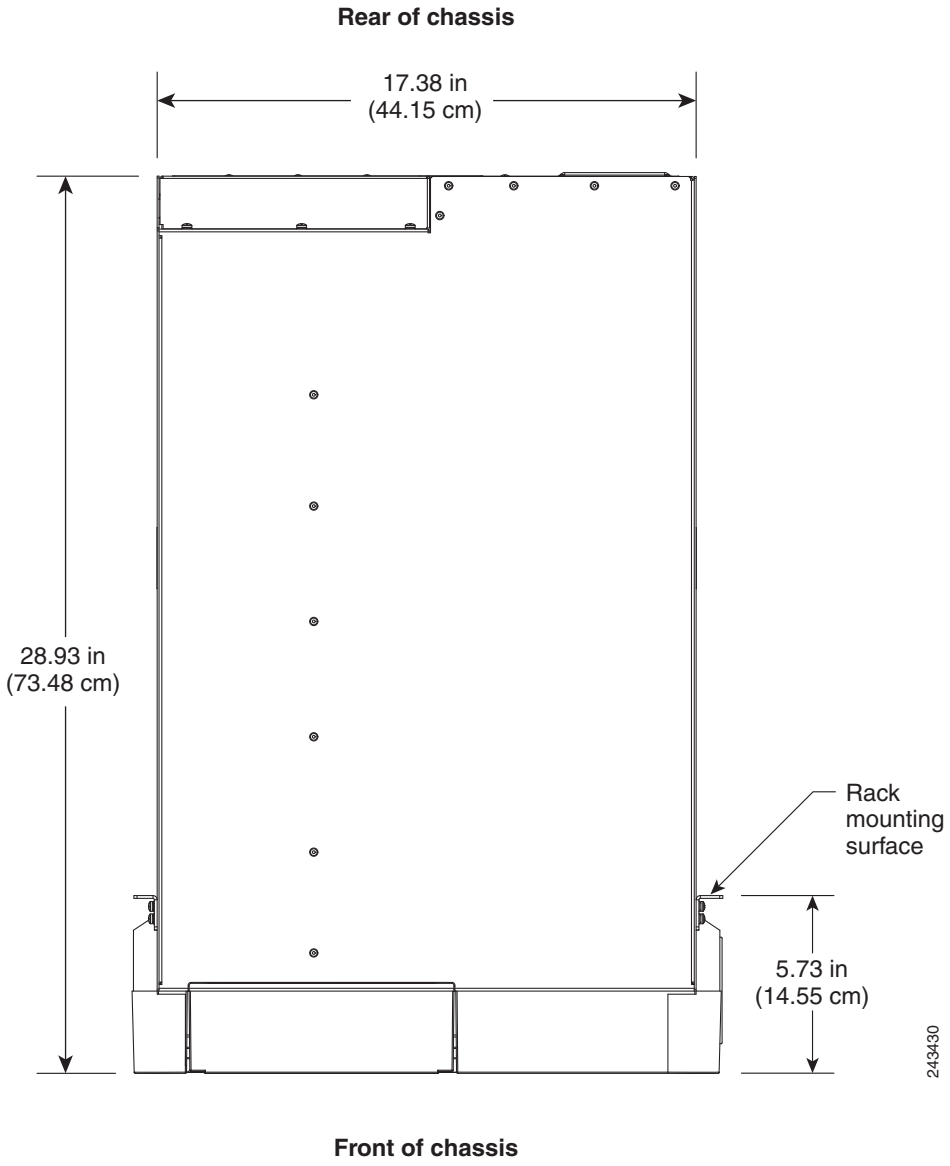


Figure 1-10 Cisco ASR 9904 Router Chassis Footprint Dimensions—Top Down View

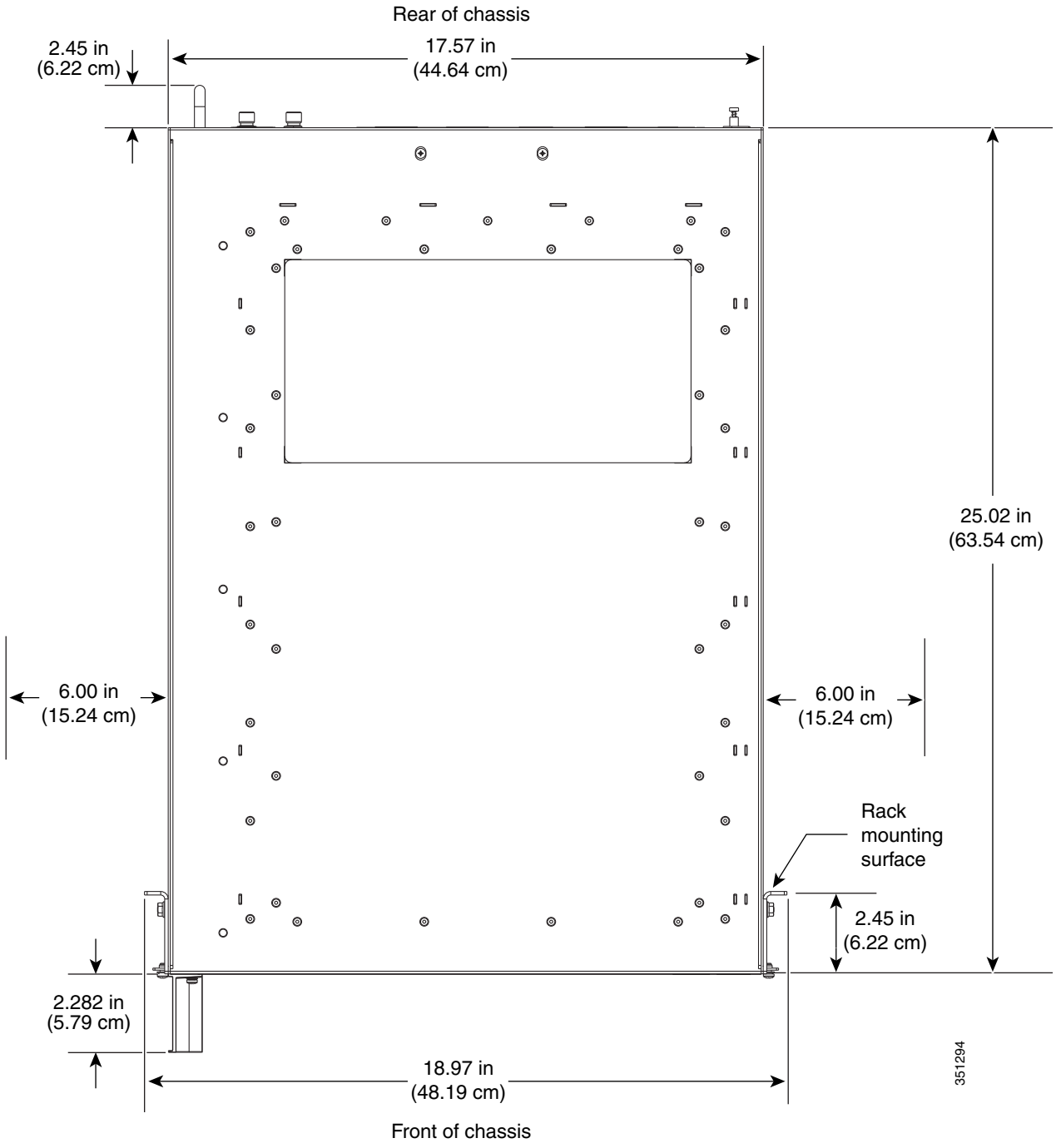


Figure 1-11 Cisco ASR 9922 Router Chassis Footprint Dimensions—Top Down View

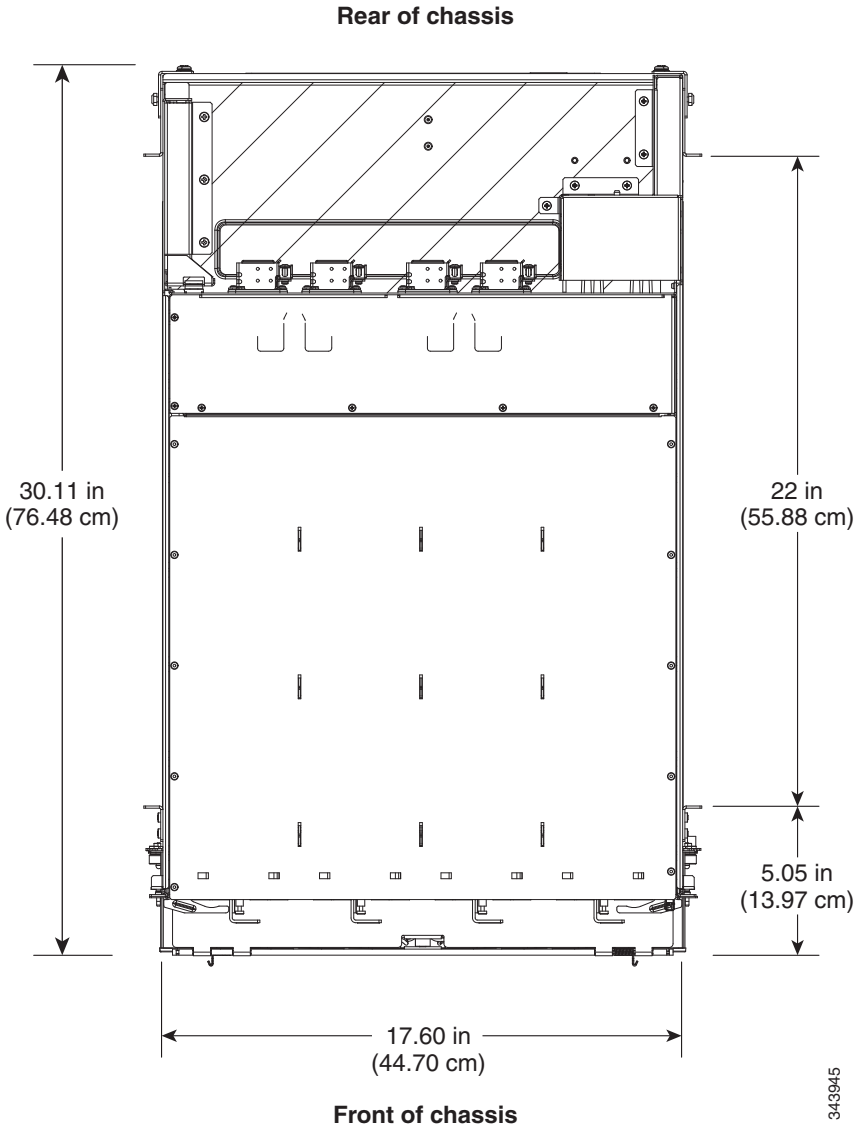
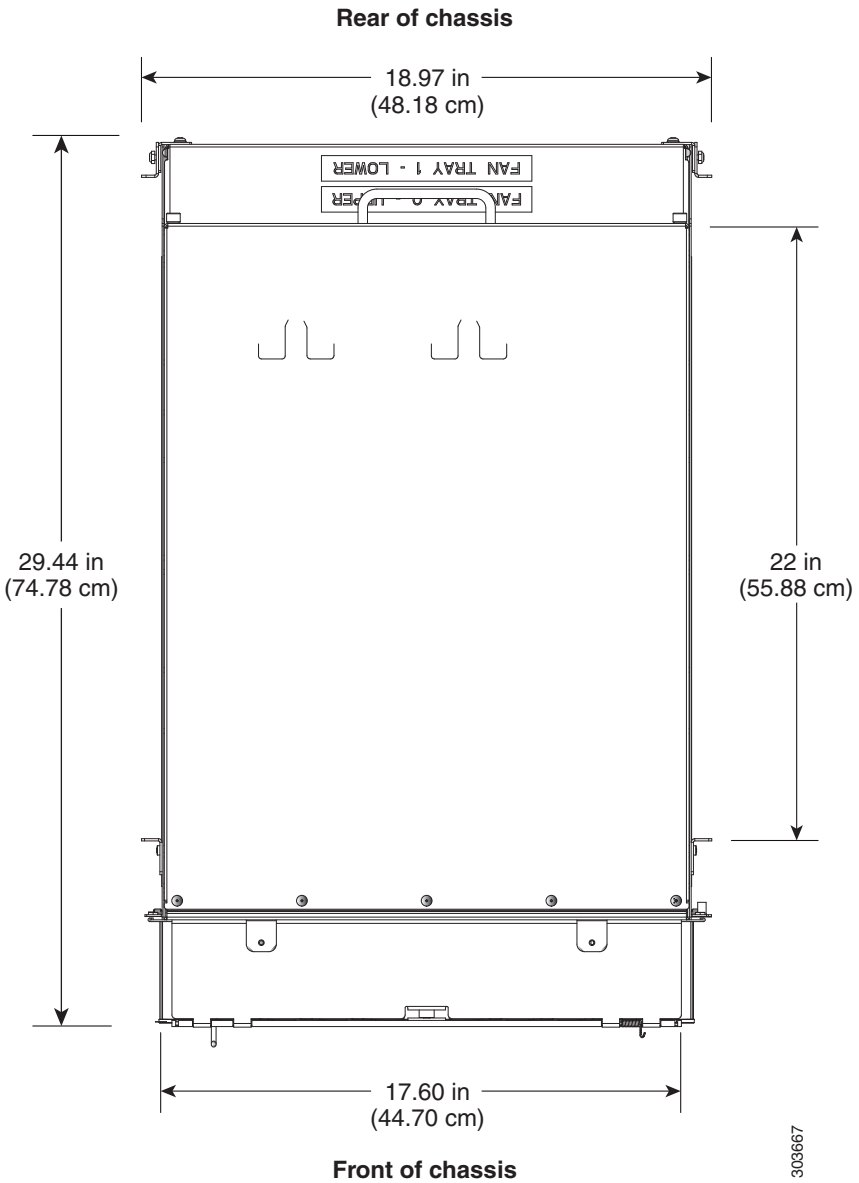


Figure 1-12 Cisco ASR 9912 Router Chassis Footprint Dimensions—Top Down View



Chassis Slots

All Cisco ASR 9010 Router chassis line cards and RSP cards are front-facing and mounted vertically, with ejector levers and captive screws at the top and bottom of each card.

All Cisco ASR 9006 Router and Cisco ASR 9904 Router chassis line cards and RSP cards are front-facing and mounted horizontally, with ejector levers and captive screws at the left and right ends of each card.

All Cisco ASR 9922 Router chassis RP, FC, and line cards are front-facing and mounted vertically, with ejector levers and captive screws at the top and bottom of each card.

All Cisco ASR 9912 Router chassis RP, FC, and line cards are front-facing and mounted vertically, with ejector levers and captive screws at the top and bottom of each card.

The chassis components include:

- Two RSP cards in the Cisco ASR 9010 Router, Cisco ASR 9006 Router, and Cisco ASR 9904 Router.
- Two RP and seven FC cards in the Cisco ASR 9922 Router and Cisco ASR 9912 Router
- Ethernet line cards
  - Cisco ASR 9010 Router—Up to eight
  - Cisco ASR 9006 Router—Up to four
  - Cisco ASR 9904 Router—Up to two
  - Cisco ASR 9922 Router—Up to twenty
  - Cisco ASR 9912 Router—Up to ten
- Backplane(s)
  - Cisco ASR 9010 Router—One
  - Cisco ASR 9006 Router—One
  - Cisco ASR 9904 Router—One
  - Cisco ASR 9922 Router—Two
  - Cisco ASR 9912 Router—One
- BPID card(s)
  - Cisco ASR 9010 Router—One
  - Cisco ASR 9006 Router—One
  - Cisco ASR 9904 Router—One
  - Cisco ASR 9922 Router—Two
  - Cisco ASR 9912 Router—One
- Fan tray controllers
  - Cisco ASR 9010 Router—Two
  - Cisco ASR 9006 Router—Two
  - Cisco ASR 9904 Router—One
  - Cisco ASR 9922 Router—Four
  - Cisco ASR 9912 Router—Two
- Power trays
  - Cisco ASR 9010 Router—Two AC power trays in AC-powered systems or two DC power trays in DC-powered systems
  - Cisco ASR 9006 Router—One AC power tray in AC-powered systems or one DC power tray in DC-powered systems
  - Cisco ASR 9904 Router—One AC power tray in AC-powered systems or one DC power tray in DC-powered systems
  - Cisco ASR 9922 Router—Four AC power trays in AC-powered systems or four DC power trays in DC-powered systems

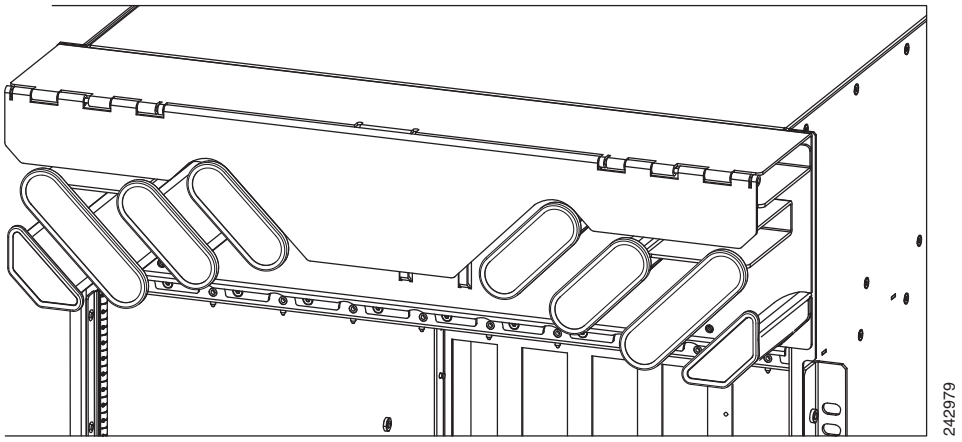
– Cisco ASR 9912 Router—Three AC power trays in AC-powered systems or three DC power trays in DC-powered systems

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

Fiber and Interface Cable Management

Figure 1-13 shows how card interface cables are managed at the front of the Cisco ASR 9010 Router chassis using a cable management tray.

Figure 1-13 Cable Management Tray



The cable management tray is located above the card cage (the Cisco ASR 9922 Router and Cisco ASR 9912 Router have an additional cable management tray below the bottom 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.

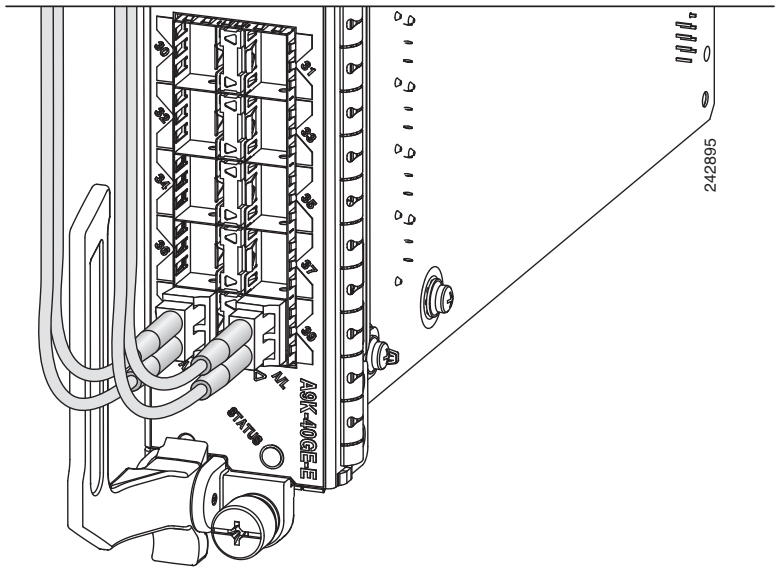
Line cards and RSP/RP cards share the same cable management tray. Cables to a card must be disconnected before its removal (this does not affect adjacent cards). Removal of a line card or RSP/RP card does not require removal or adjustment of cables other than those associated with the card itself.

A cable management bend radius of 1.5 inches (3.81 cm) 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.

Figure 1-14 shows how the fiber and cables are routed upward away from slot number labels. Therefore slot number labels, located at the lower part of the card cage, are not obscured by the cables.

Figure 1-14 Fiber/Cable Routing in the Cisco ASR 9010 Router

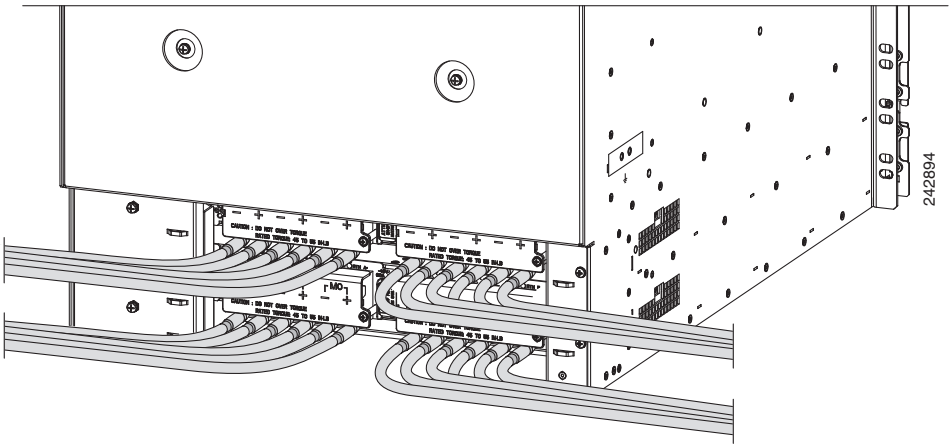


Routing of DC Power Tray Source Cables

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 1-15 shows the DC power cable routing on the power trays.

Figure 1-15 Routing of DC Power Tray Source Cables



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 1-16 shows slot ID numbering for the Cisco ASR 9010 Router with version 1 power trays.

Figure 1-17 shows slot ID numbering for the Cisco ASR 9010 Router with version 2 power trays.

Figure 1-16 Cisco ASR 9010 Router Router Slot ID Numbering—Version 1 Power Trays

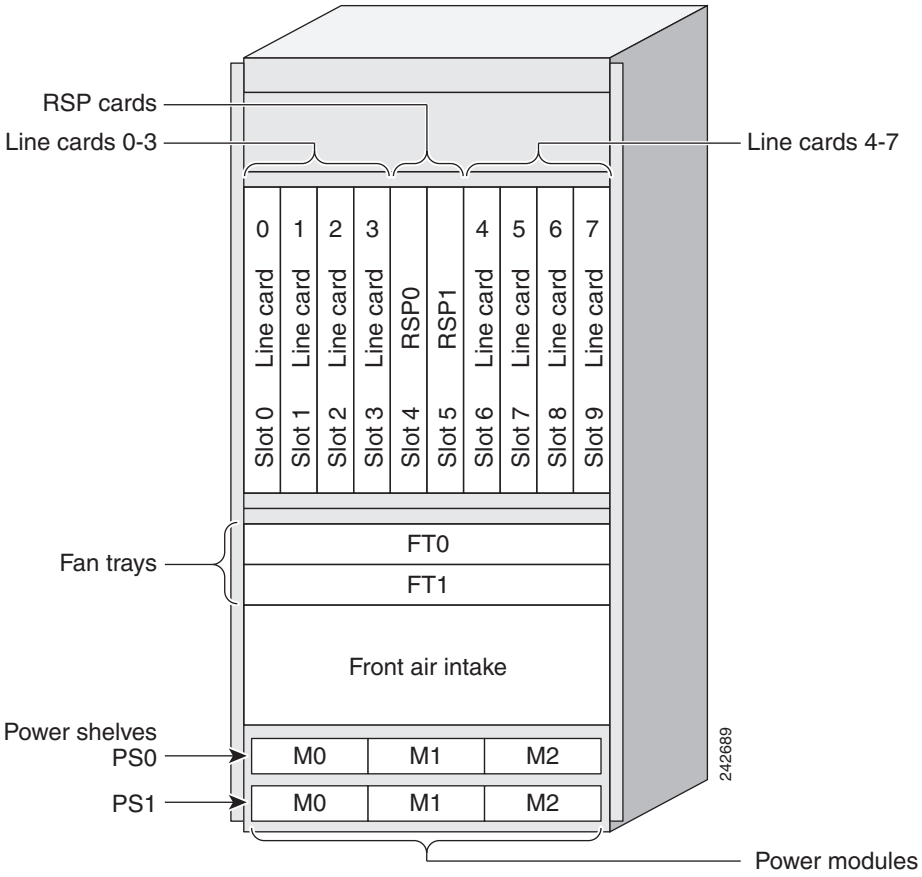


Figure 1-17 Cisco ASR 9010 Router Slot ID Numbering—Version 2 Power Trays

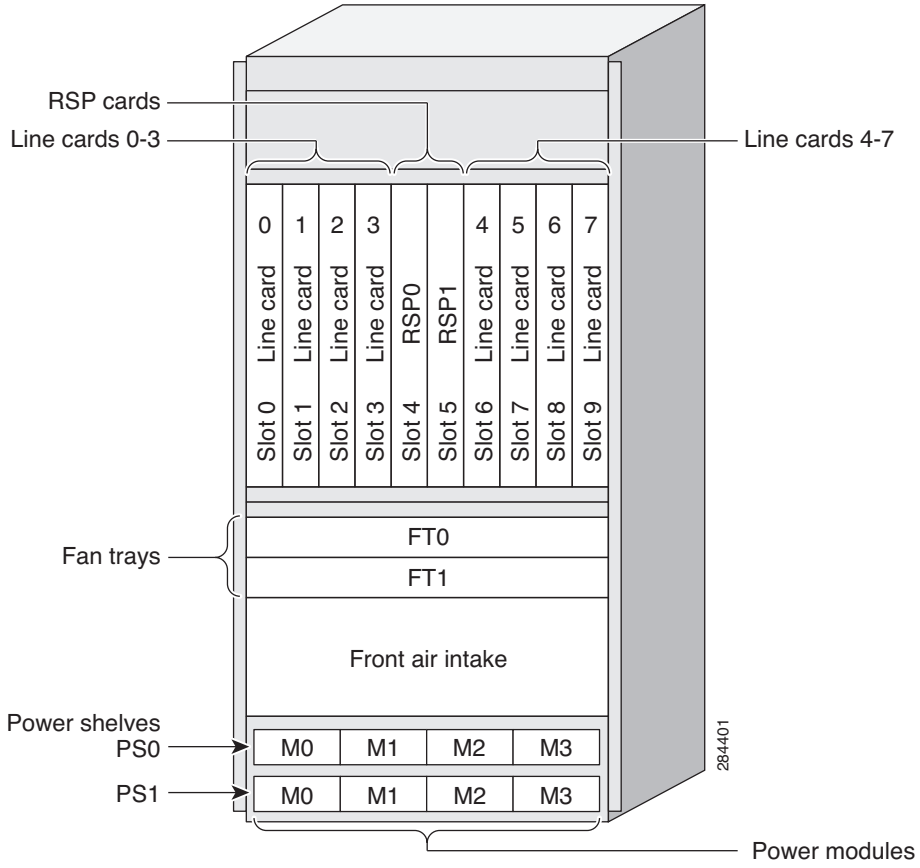


Figure 1-18 shows slot ID numbering for the Cisco ASR 9006 Router with the version 1 power tray.
Figure 1-19 shows slot ID numbering for the Cisco ASR 9006 Router with the version 2 power tray.

Figure 1-18 Cisco ASR 9006 Router Slot ID Numbering—Version 1 Power Tray

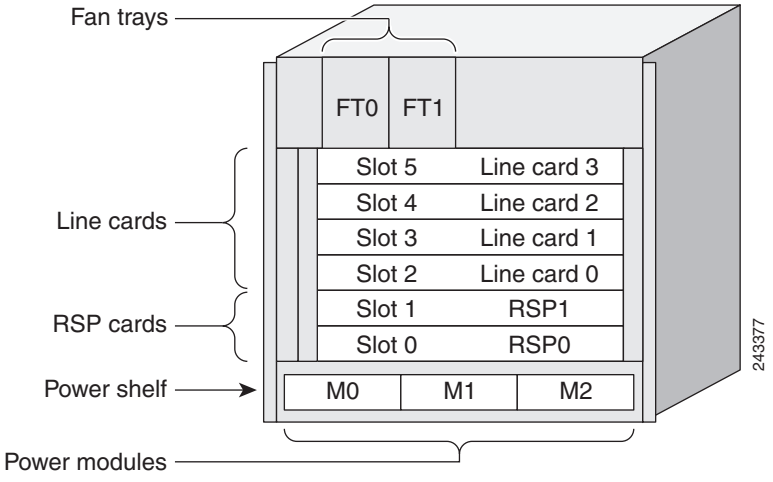


Figure 1-19 Cisco ASR 9006 Router Slot ID Numbering—Version 2 Power Tray

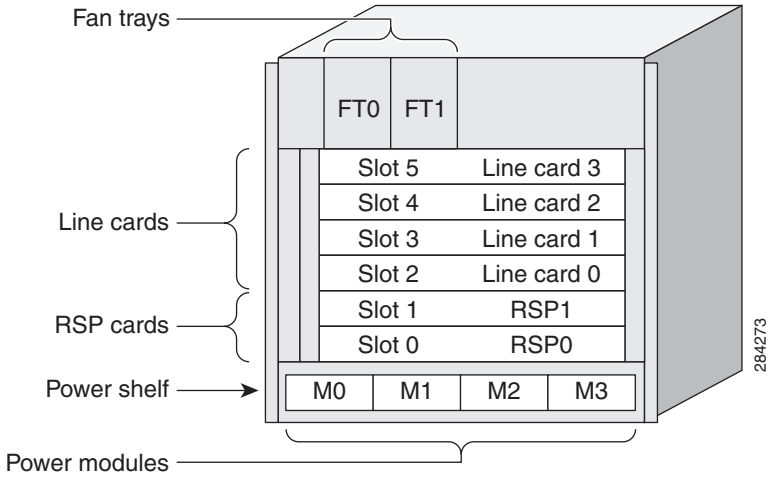


Figure 1-20 shows slot ID numbering for the Cisco ASR 9904 Router with the version 2 power tray.

Figure 1-20 Cisco ASR 9904 Router Slot ID Numbering—Version 2 Power Tray

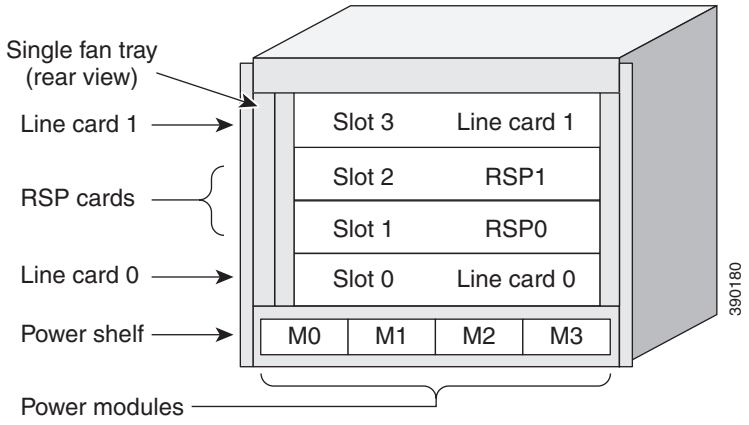


Figure 1-21 shows slot numbering for the Cisco ASR 9922 Router with version 2 power trays.

Figure 1-22 shows slot numbering for the Cisco ASR 9912 Router with version 2 power trays.

Note For the Cisco ASR 9922 Router, line cards must be installed upside down in slots 10 through 19 of the bottom card cage, whereas in slots 0 though 9 of the top card cage, the line cards are installed right side up.

Figure 1-21 Cisco ASR 9922 Router Components and Slot Numbering

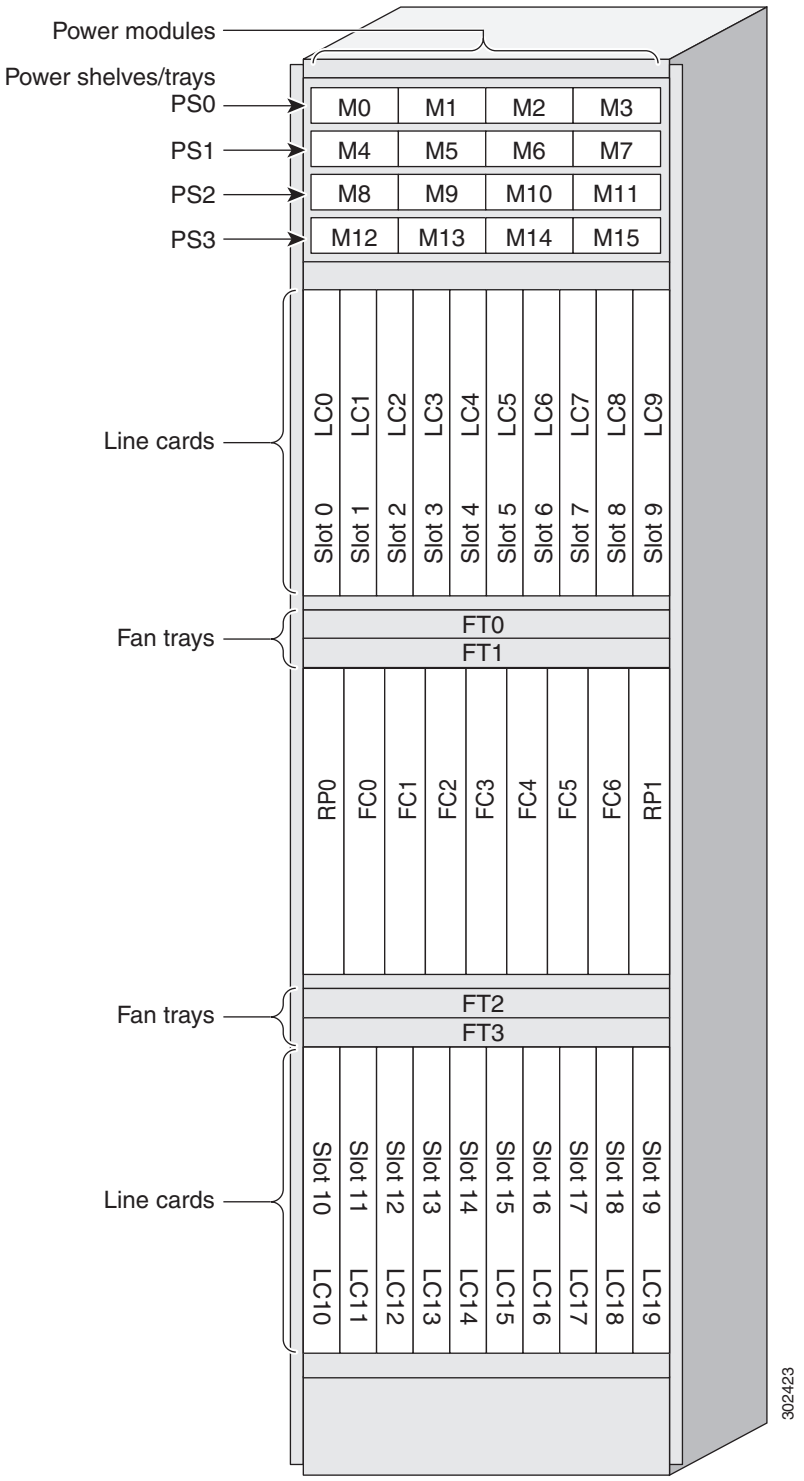
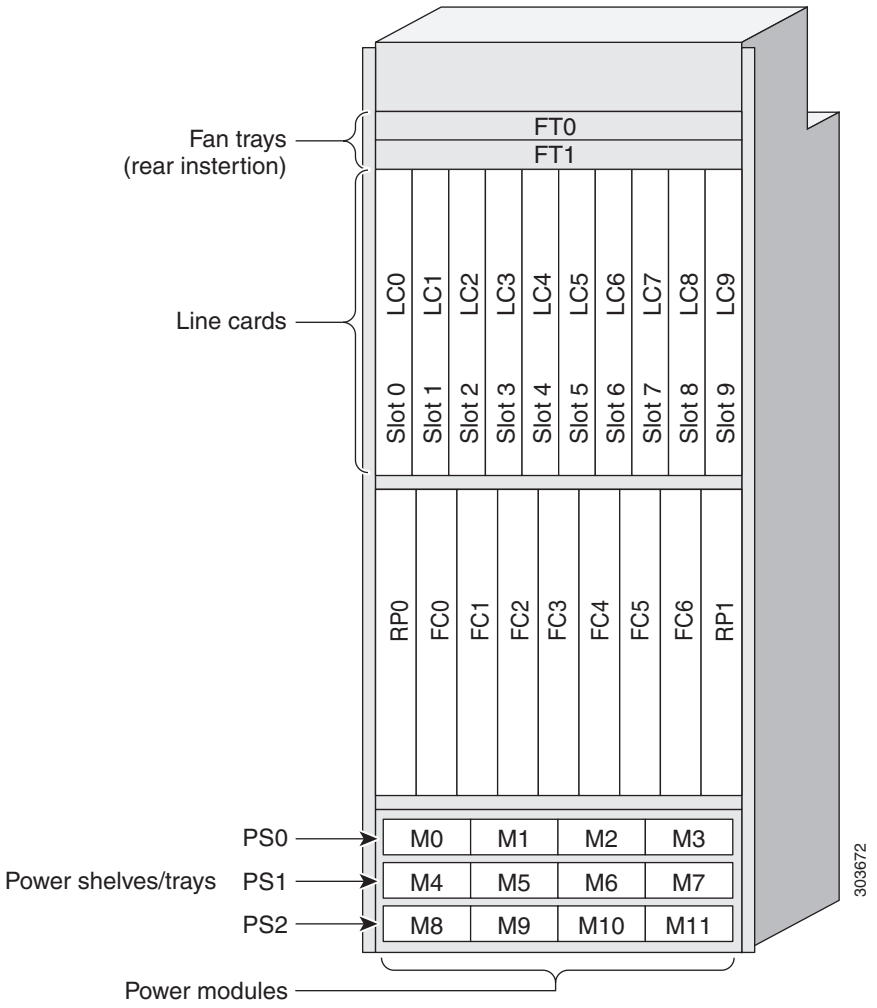


Figure 1-22 Cisco ASR 9912 Router Components and Slot Numbering



Power Module Hardware and Software Identification

The power modules have software IDs that differ from the hardware ID labels on the chassis shown in the figures above. Table 1-1 lists the hardware IDs and the corresponding software IDs for the power modules.

Table 1-1 Power Module Hardware and Software IDs

Hardware ID	Software ID
PS0 M0	PM0
PS0 M1	PM1
PS0 M2	PM2
PS0 M3	PM3
PS1 M0	PM4

Table 1-1 Power Module Hardware and Software IDs

Hardware ID	Software ID
PS1 M1	PM5
PS1 M2	PM6
PS1 M3	PM7
PS2 M0	PM8
PS2 M1	PM9
PS2 M2	PM10
PS2 M3	PM11
PS3 M0	PM12
PS3 M1	PM13
PS3 M2	PM14
PS3 M3	PM15

Route Switch Processor and Route Processor Cards

The RSP card is the main control and switch fabric element in the Cisco ASR 9010 Router, and Cisco ASR 9006 Router, and Cisco ASR 9904 Router. To provide redundancy, there can be two RSP cards in each router, 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.

The RP card is the main control element in the Cisco ASR 9922 Router and Cisco ASR 9912 Router. The RP card provides centralized chassis control, management, and data-plane switching. To provide redundancy, there are two RP cards in each router, one as the active control RP and the other as the standby RP. The standby RP takes over all control functions should the active RP fail.

On the Cisco ASR 9922 Router and Cisco ASR 9912 Router, the switch fabric has been moved to FC cards.

RSP Front Panel and Access Ports

System alarms reside on the RSP. Alarms 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 (not on RSP-440)
- 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 dual-speed 100/1000 Mbit Ethernet Management ports
- One 4 character 5x7 LED dot matrix display and discrete status LEDs
- Alarm Cut Off (ACO) and Lamp Test momentary push buttons
- Two RJ-45 Sync timing ports with Link and Fault LEDs built into the RJ-45
- Alarm Output DB9 port with three alarm outputs

Figure 1-23 shows the front panel of the RSP card.

Figure 1-23 RSP Card Front Panel

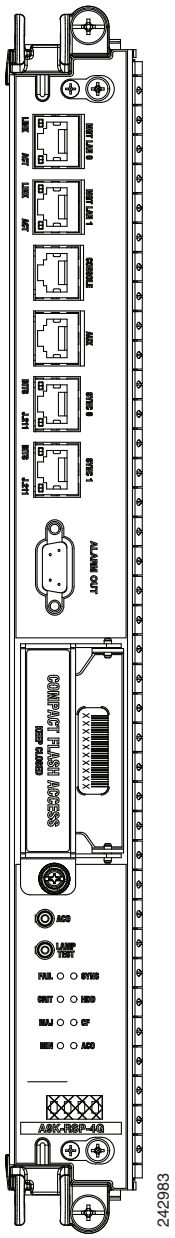
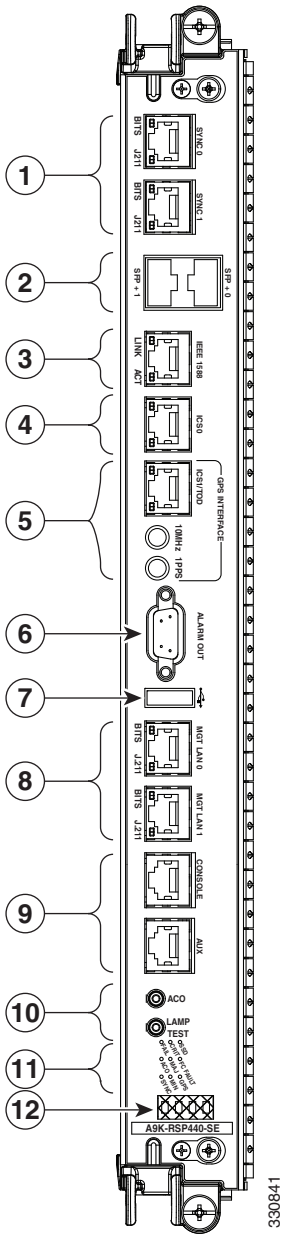


Figure 1-24 shows the front panel of the RSP-440 card.

Figure 1-24 RSP-440 Card Front Panel



1	SYNC (BITS/J.211) ports	**7**	External USB port
2	SFP/SFP+ ports	**8**	Management LAN ports
3	IEEE 1588 port	**9**	CONSOLE and AUX ports
4	ToD port	**10**	Alarm Cutoff (ACO) and Lamp Test push buttons
5	10 MHz and 1 PPS indicators	**11**	Eight discrete LED indicators
6	Alarm Out DB9 connector	**12**	LED matrix display

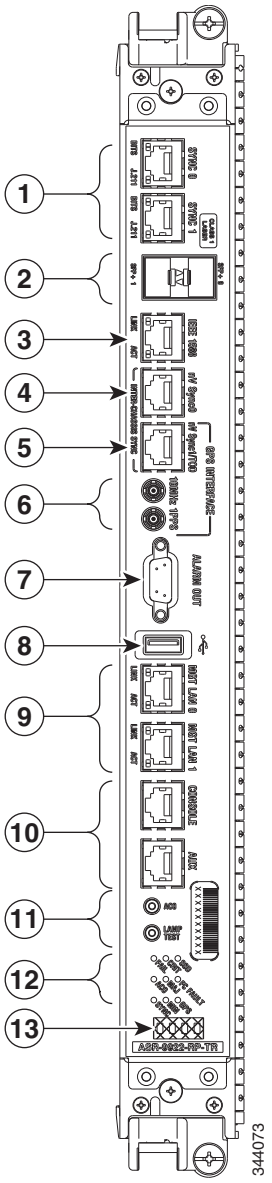
RP Front Panel and Access Ports

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

- Two BITS RJ-45 Sync timing ports
- Two 10 GE SFP/SFP+ ports
- IEEE1588 RJ-45 Timestamp port
- RS232/422 GPS TOD RJ-45 port for system timing input
- 10 MHz and 1 PPS clock input SMB ports
- Alarm Output DB9 port with three alarm outputs
- External USB2, class-A port
- Two RJ-45 100/1000 Mbit Ethernet Management ports
- RJ-45 Console port
- RJ-45 Auxiliary (AUX) port
- Alarm Cut Off (ACO) and Lamp Test momentary push buttons
- RP Discrete Status LEDs
  - SSD LED
  - FC Fault LED
  - GPS LED
  - Critical Alarm LED (red)
  - Major Alarm LED (red)
  - Minor Alarm LED (amber)
  - Power Fail LED
  - ACO LED (amber)
  - SYNC LED (green and amber)
- One 4-character 5x7 LED dot-matrix display

Figure 1-25 shows the front panel of the RP card.

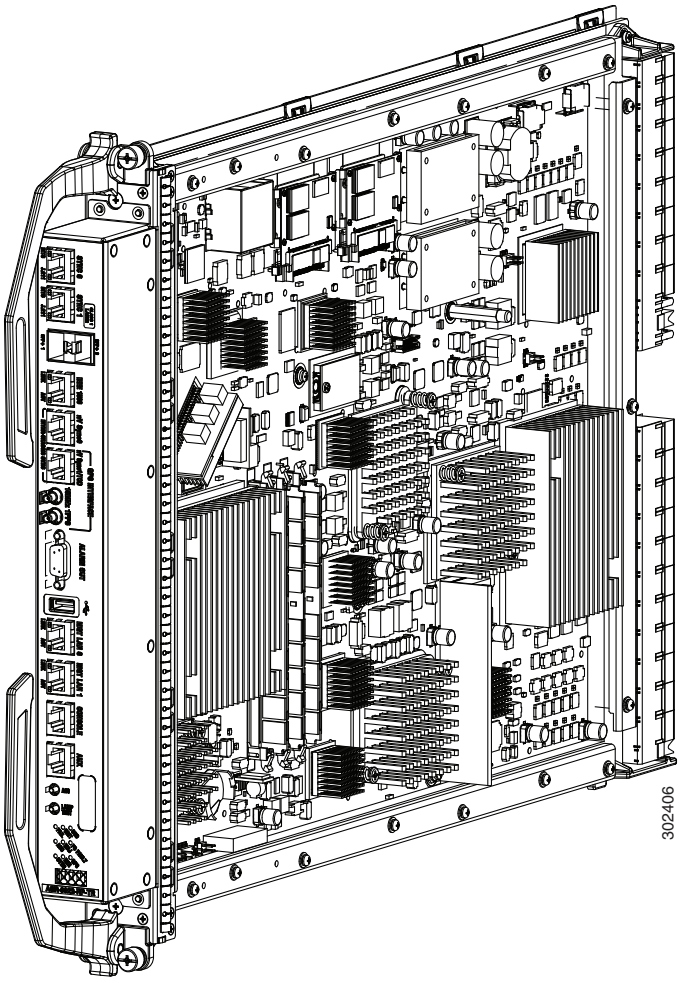
Figure 1-25 RP Card Front Panel



1	SYNC (BITS/J.211) ports	**8**	External USB port
2	SFP/SFP+ ports	**9**	Management LAN ports
3	IEEE 1588 port	**10**	CONSOLE and AUX ports
4	Inter-chassis nv Sync0	**11**	Alarm Cutoff (ACO) and Lamp Test push buttons
5	Inter-chassis nv Sync1 GPS ToD	**12**	Nine discrete LED indicators
6	10 MHz and 1 PPS indicators	**13**	LED matrix display
7	Alarm Out DB9 connector		

Figure 1-26 shows the RP card.

Figure 1-26 RP Card



Management Features

Two management LAN ports (MGT LAN 0, MGT LAN 1) are provided on the RSP/RP 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/RP 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/RP 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.

Alarm Connector

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

Serviceability

RSP/RP cards can be inserted or removed when adjacent (cabled) RSP/RP 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/RP card.

RSP and RP Card Ejector Levers

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

Fabric Controller Card

On the Cisco ASR 9922 Router and Cisco ASR 9912 Router, the switch fabric has been moved to FC cards.

The switch fabric is configured as a single stage of switching with multiple parallel planes. The switch fabric is responsible for transporting packets from one line card to another but has no packet processing capabilities. Each fabric plane is a single-stage, non-blocking, packet-based, store-and-forward switch. To manage fabric congestion, the RP provides centralized Virtual Output Queue (VOQ) arbitration.

The switch fabric is capable of delivering 550-Gbps per line card slot. When five FC cards are installed in the chassis, the switch fabric is 4+1 redundant. When all seven FC cards are installed in the chassis, the switch fabric is 6+1 redundant. The switch fabric is fully redundant, with one copy of the fabric on each FC, and each FC carries enough switching capacity to meet the chassis throughput specifications.

Figure 1-27 shows the FC card.

Figure 1-27 FC Card

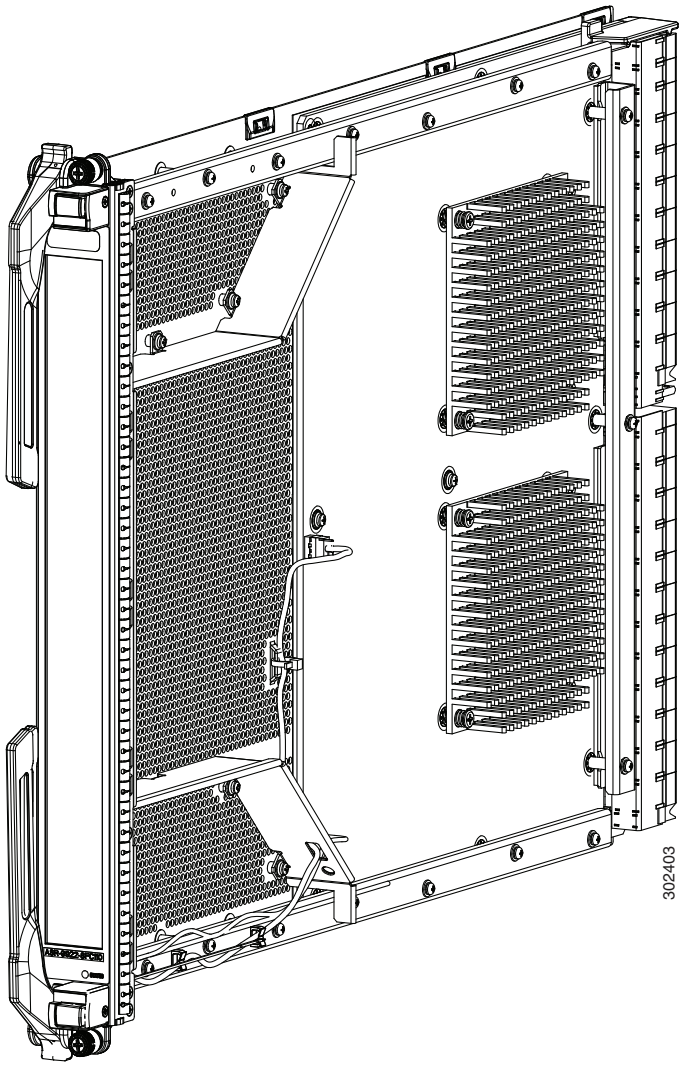
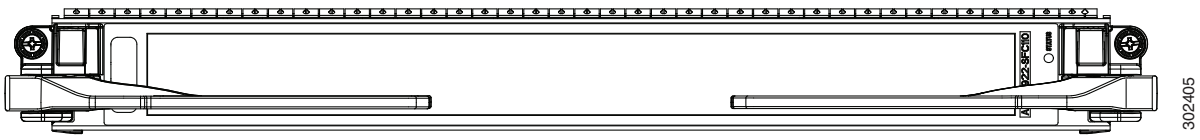


Figure 1-28 shows the front panel of the FC card. The front panel has a status LED, ejector levers, ejector lever release buttons, and mounting screws.

Figure 1-28 FC Card Front Panel



FC Card Ejector Levers

Ejector levers are provided for inserting and removing the FC cards from the backplane connectors. The insertion and removal force of the card ejector levers is about 16 lbs (7.27 kg). To release the ejector levers, push in the ejector lever release buttons.

Note Once any ejector lever release button is pushed in, the FC card must by physically removed and reinserted (OIR) to restart the FC card.

Ethernet Line Cards

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

- 40-port Gigabit Ethernet with SFP (small form-factor pluggable) optics
- 4-port 10-Gigabit Ethernet line rate card with XFP optics
- 8-port 10-Gigabit Ethernet 2:1 oversubscribed card with XFP optics
- 8-port 10-Gigabit Ethernet 80-Gbps line rate card with XFP optics
- Combination 2-port 10-Gigabit Ethernet plus 20-port Gigabit Ethernet card with XFP and SFP optics
- 16-port 10-Gigabit Ethernet oversubscribed card with SFP+ optics
- 24-port 10-GE DX Line Card, Packet Transport Optimized with SFP+ optics
- 24-port 10-GE DX Line Card, Service Edge Optimized with SFP+ optics
- 36-port 10-GE DX Line Card, Packet Transport Optimized with SFP+ optics
- 36-port 10-GE DX Line Card, Service Edge Optimized with SFP+ optics
- 2-port 100-GE DX Line Card, Packet Transport Optimized with CFP optics
- 2-port 100-GE DX Line Card, Service Edge Optimized with CFP optics
- 1-port 100-GE DX Line Card, Packet Transport Optimized with CFP optics
- 1-port 100-GE DX Line Card, Service Edge Optimized with CFP optics
- 80 Gigabyte Modular Line Card, Packet Transport Optimized
- 80 Gigabyte Modular Line Card, Service Edge Optimized
- 160 Gigabyte Modular Line Card, Packet Transport Optimized
- 160 Gigabyte Modular Line Card, Service Edge Optimized
- 20-port GE Modular Port Adapter (MPA) with SFP optics
- 8-port 10-GE MPA with SFP+ optics
- 4-port 10-GE MPA with XFP optics
- 2-port 10-GE MPA with XFP optics
- 2-port 40-GE MPA with QSFP+ optics
- 1-port 40-GE MPA with QSFP+ optics

For line card installation information, see:

Cisco ASR 9000 Series Aggregation Services Routers Ethernet Line Card Installation Guide

In addition to the line cards listed here, a SPA Interface Processor (SIP) and Shared Port Adapters (SPA) are supported on the Cisco ASR 9000 Series Routers. For information about these components, see:

Cisco ASR 9000 Aggregation Services Router SIP and SPA Hardware 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/RP activates dry contact closures that are accessible through a nine-pin connector on the RSP/RP faceplate.

See the "Ethernet Line Cards" section on page 2-21 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 Levers

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

Power System

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—AC/DC bulk power supply tray connected to the user 200 to 240 VAC +/- 10 percent (180 to 264 VAC) source
- DC systems—DC/DC bulk power supply tray connected to the user Central Office DC battery source –48 VDC/–60 VDC (–54 VDC nominal)

DC output power from each power tray 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 backplane 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 power tray houses up to four power modules.

- The AC and DC power trays in the Cisco ASR 9006 Router and Cisco ASR 9904 Router provide N+1 redundancy.
- The AC power trays in the Cisco ASR 9010 Router, Cisco ASR 9922 Router, and Cisco ASR 9912 Router provide N+N redundancy. The DC power trays provide N+1 redundancy.

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

Figure 1-29 shows a front view of six version 1 power modules in the Cisco ASR 9010 Router.

Figure 1-29 Front System View of Power Trays—Cisco ASR 9010 Router with Version 1 Power Trays

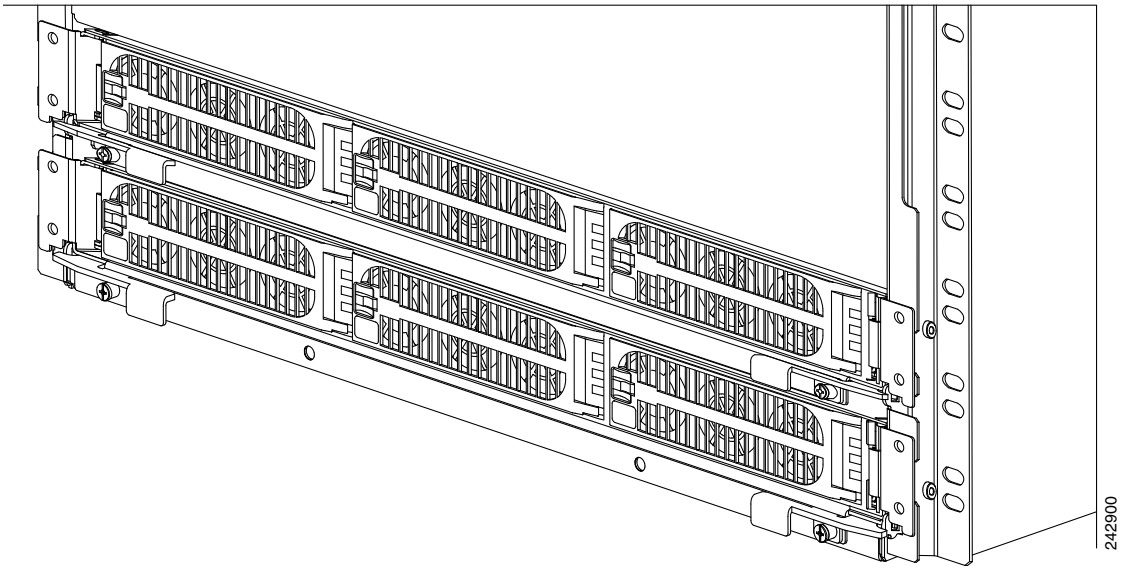
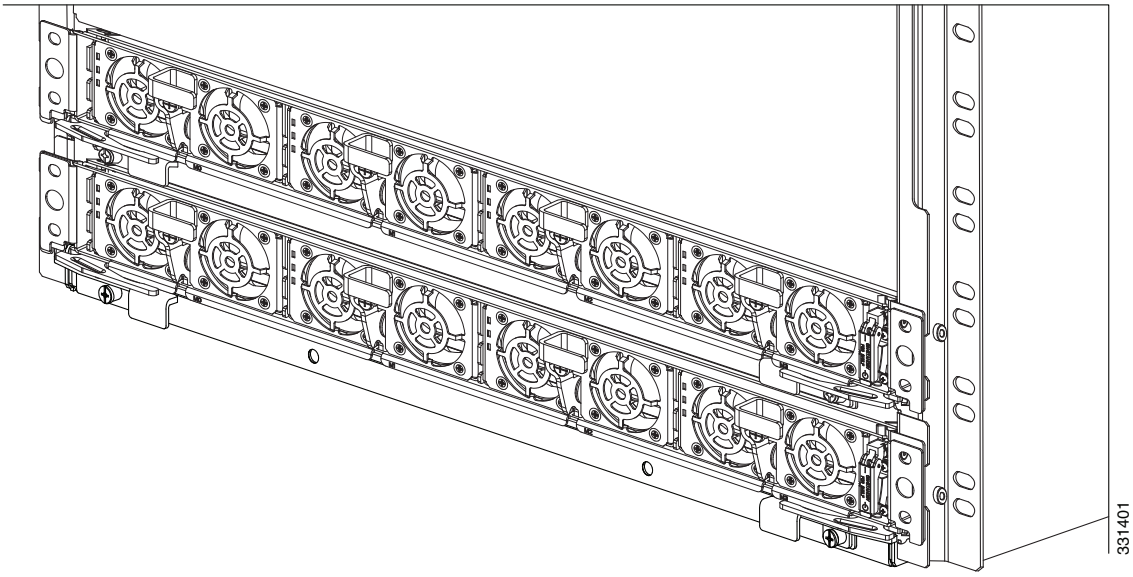


Figure 1-30 shows a front view of eight version 2 power modules in the Cisco ASR 9010 Router.

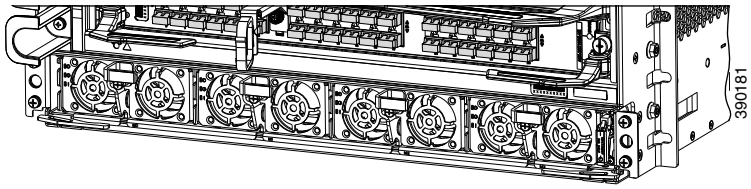
Figure 1-30 Front System View of Power Trays—Cisco ASR 9010 Router with Version 2 Power Trays



The Cisco ASR 9006 Router and Cisco ASR 9904 Router are similar, except that:

- The Cisco ASR 9006 Router supports one power tray with up to three version 1 power modules or four version 2 power modules.
- The Cisco ASR 9904 Router supports one power tray with up to four version 2 power modules (see Figure 1-31).

Figure 1-31 Front System View of Power Tray—Cisco ASR 9904 Router with Version 2 Power Tray

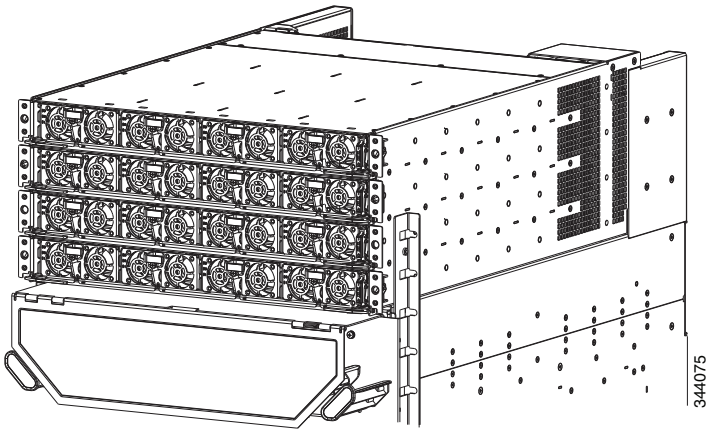


- To operate the Cisco ASR 9922 Router on AC power, four AC power trays should be installed, each with up to four power modules which are fed by a single-phase 220-V 20-A branch circuit. Eight power modules are enough to power a fully-populated chassis. Sixteen power modules are required for N+N redundancy. Fewer power modules can be used if the chassis is populated with fewer line cards.
- To operate the Cisco ASR 9922 Router on DC power, four DC power trays should be installed, each with up to four power modules which are fed by separate pairs of redundant –48-V 60-A branch sources. Fifteen power modules are enough to power a fully-populated chassis. Sixteen power modules are required for N+1 redundancy. Fewer power modules can be used if the chassis is populated with fewer line cards.

- To operate the Cisco ASR 9912 Router on AC power, three AC power trays should be installed, each with up to four power modules which are fed by a single-phase 220-V 20-A branch circuit. Six power modules are enough to power a fully-populated chassis. Twelve power modules are required for N+N redundancy. Fewer power modules can be used if the chassis is populated with fewer line cards.
- To operate the Cisco ASR 9912 Router on DC power, three DC power trays should be installed, each with up to four power modules which are fed by separate pairs of redundant –48-V 60A branch sources. Eleven power modules are enough to power a fully-populated chassis. Twelve power modules are required for N+1 redundancy. Fewer power modules can be used if the chassis is populated with fewer line cards.

Figure 1-32 shows the front view of sixteen version 2 power modules installed in the Cisco ASR 9922 Router.

Figure 1-32 Front System View of Power Trays —Cisco ASR 9922 Router with Version 2 Power Trays



Cooling System

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

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

In the Cisco ASR 9006 Router, the two fan trays are located above the card cage, left of center, and side by side. They are covered by a fan tray door hinged at the bottom, which must be opened before removing the fan trays.

In the Cisco ASR 9904 Router, a single fan tray is located in the rear, right side of the card cage and is equipped with a handle for easy insertion.

In the Cisco ASR 9922 Router, the two top fan trays are located between the top and middle cages, whereas the two bottom fan trays are located between the middle and bottom cages. The two bottom fan trays are inserted *upside down* compared to the two top fan trays. In the Cisco ASR 9912 Router, the two fan trays are located above the line card cage. Each fan tray holds 12 axial fans and includes a controller that reduces the speed of the fans when the chassis temperature is within limits, thereby reducing the generation of acoustic noise. The fan controller also senses and reports individual fan failures.

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 the exhaust is at the upper rear. Figure 2-64 shows the cooling path of 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 the exhaust is at the upper rear. Figure 2-65 shows the cooling path of the Cisco ASR 9006 Router chassis.
- The Cisco ASR 9904 Router has a side-to-side cooling path. Figure 2-66 shows the cooling path of the Cisco ASR 9904 Router chassis. The inlet is at the right side of the chassis, and the exhaust is at the left side.

  If the router is installed in a 2-post 23-inch rack, air flow is circulated front-to-back. An optional air baffle accessory kit (ASR-9904-BAFFLE=) is available for mounting the router chassis in this configuration. For air baffle installation information, see:

  Cisco ASR 9000 Series Aggregation Services Router Hardware Installation Guide
- The cages of the Cisco ASR 9922 Router chassis have a front-to-rear cooling path. The inlet is at the front of the middle cage, and the exhaust is at the upper and lower rear. Figure 2-67 shows the cooling path of the Cisco ASR 9922 Router chassis.
- The Cisco ASR 9912 Router chassis has a front-to-rear cooling path. The inlet is at the front of the RP/FC card cage, and the exhaust is at the upper rear. Figure 2-68 shows the cooling path of the Cisco ASR 9912 Router chassis.

Fan Trays

The Cisco ASR 9010 Router, Cisco ASR 9006 Router, and Cisco ASR 9912 Router contain two fan trays for redundancy (see Figure 2-69, Figure 2-70, Figure 2-72). The Cisco ASR 9904 Router contains a single fan tray for redundancy (see Figure 2-71). The Cisco ASR 9922 Router contains four fan trays for redundancy (see Figure 2-72). The fan tray has an LED indicator to indicate fan tray status. If a fan fails, 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 Due to air leakage, the chassis should not be operated with any of the fan trays completely missing. Replace any missing fan tray within five minutes. Any fan tray replacement should be performed when the chassis is back to room temperature.

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. You can use CWI to edit the router configuration file, open Telnet/SSH application windows, and create user-defined applications.

Functional Description

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

Router Operation

The ASR 9000 Series Routers are fully distributed routers that use 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 I/O and forwarding engines, plus sufficient control plane resources to manage line card resources. Two slots in the chassis are reserved for RSP/RP cards to provide a single point of contact for chassis provisioning and management.

Figure 2-1 shows the platform architecture of the Cisco ASR 9010 Router, Cisco ASR 9006 Router, and Cisco ASR 9904 Router.

Figure 2-1 Cisco ASR 9010 Router, Cisco ASR 9006 Router, and Cisco ASR 9904 Router Platform Architecture

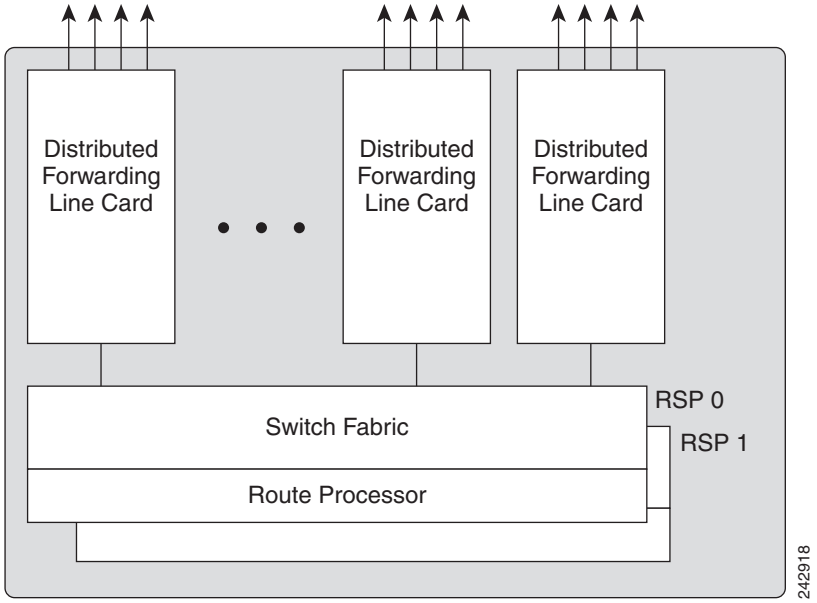


Figure 2-2 shows the platform architecture of the Cisco ASR 9922 Router and Cisco ASR 9912 Router.

Figure 2-2 Cisco ASR 9922 Router and Cisco ASR 9912 Router Platform Architecture

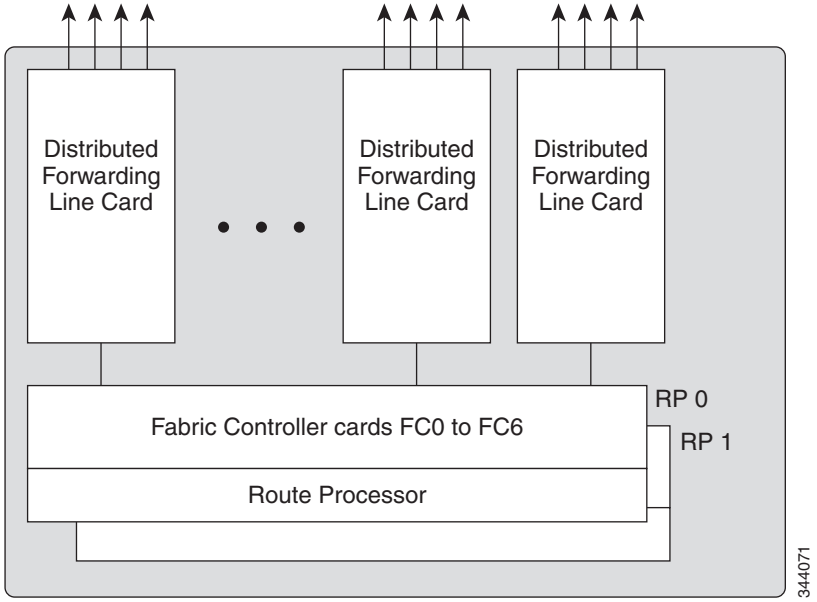


Figure 2-3 shows the major system components and interconnections of the Cisco ASR 9000 Series Routers.

Figure 2-3 Major System Components and Interconnections in the Cisco ASR 9000 Series Routers

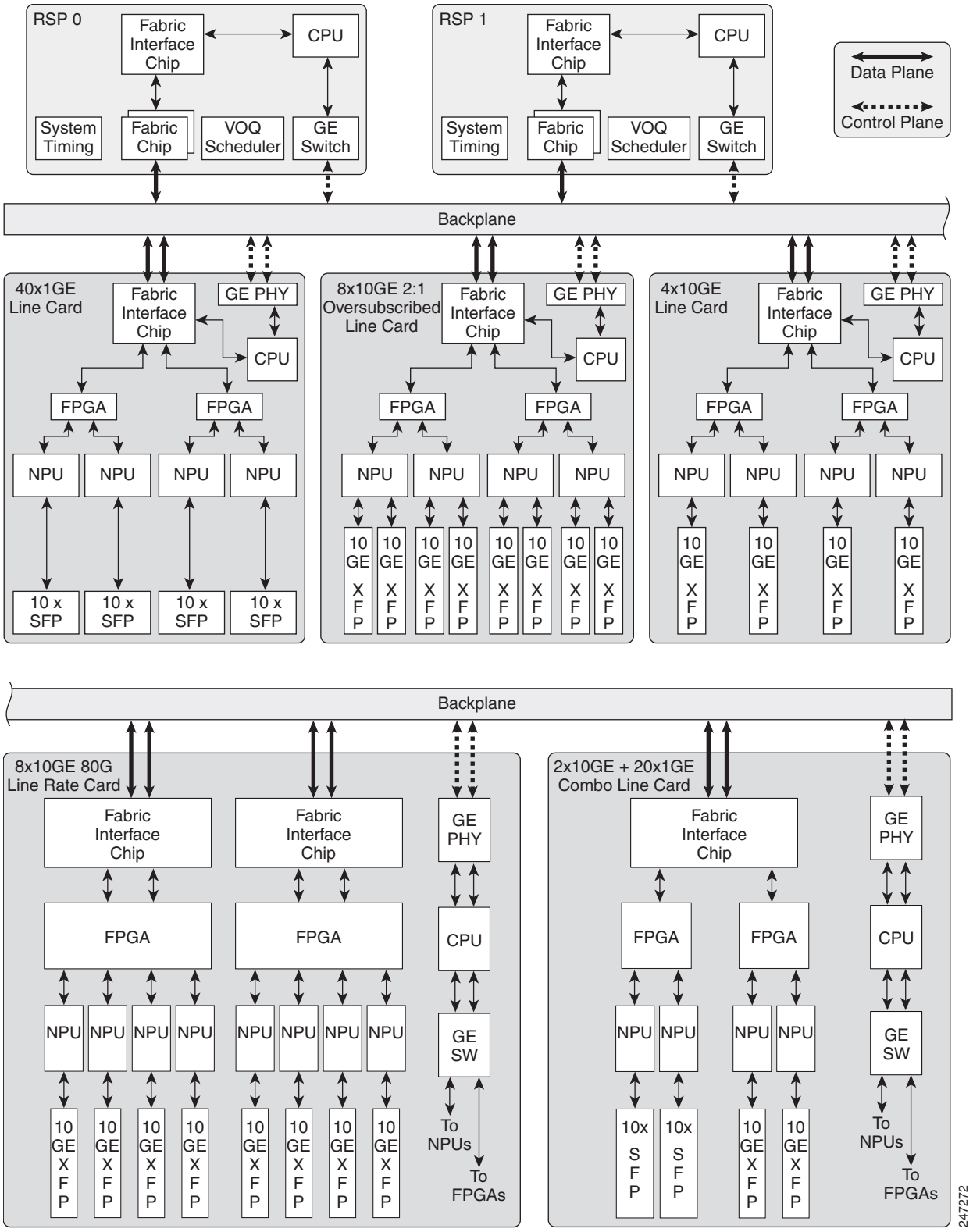


Figure 2-4 Additional System Components in the Cisco ASR 9000 Series Routers

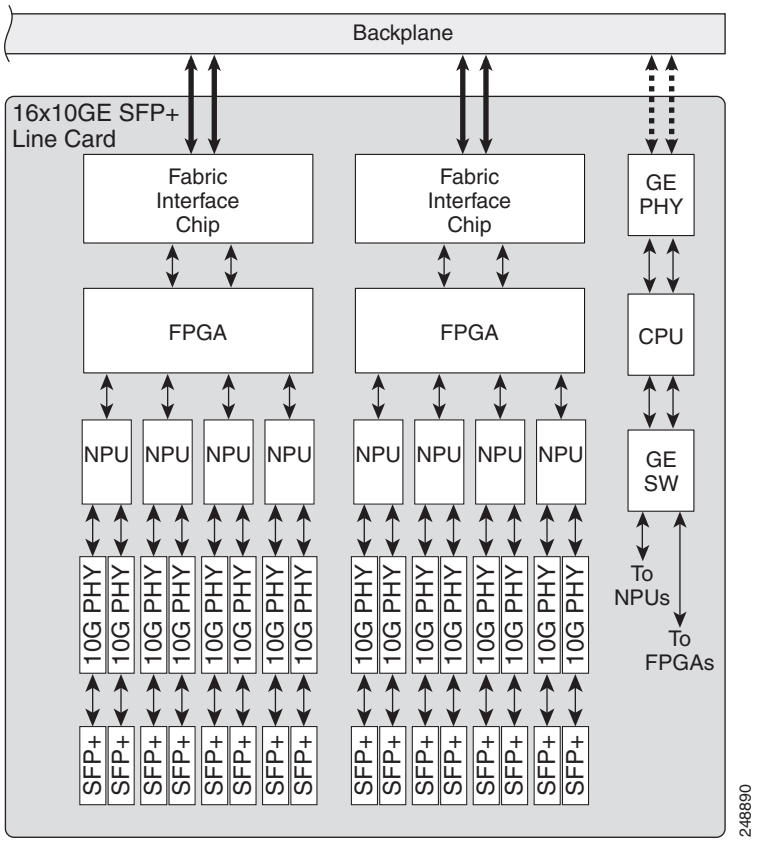
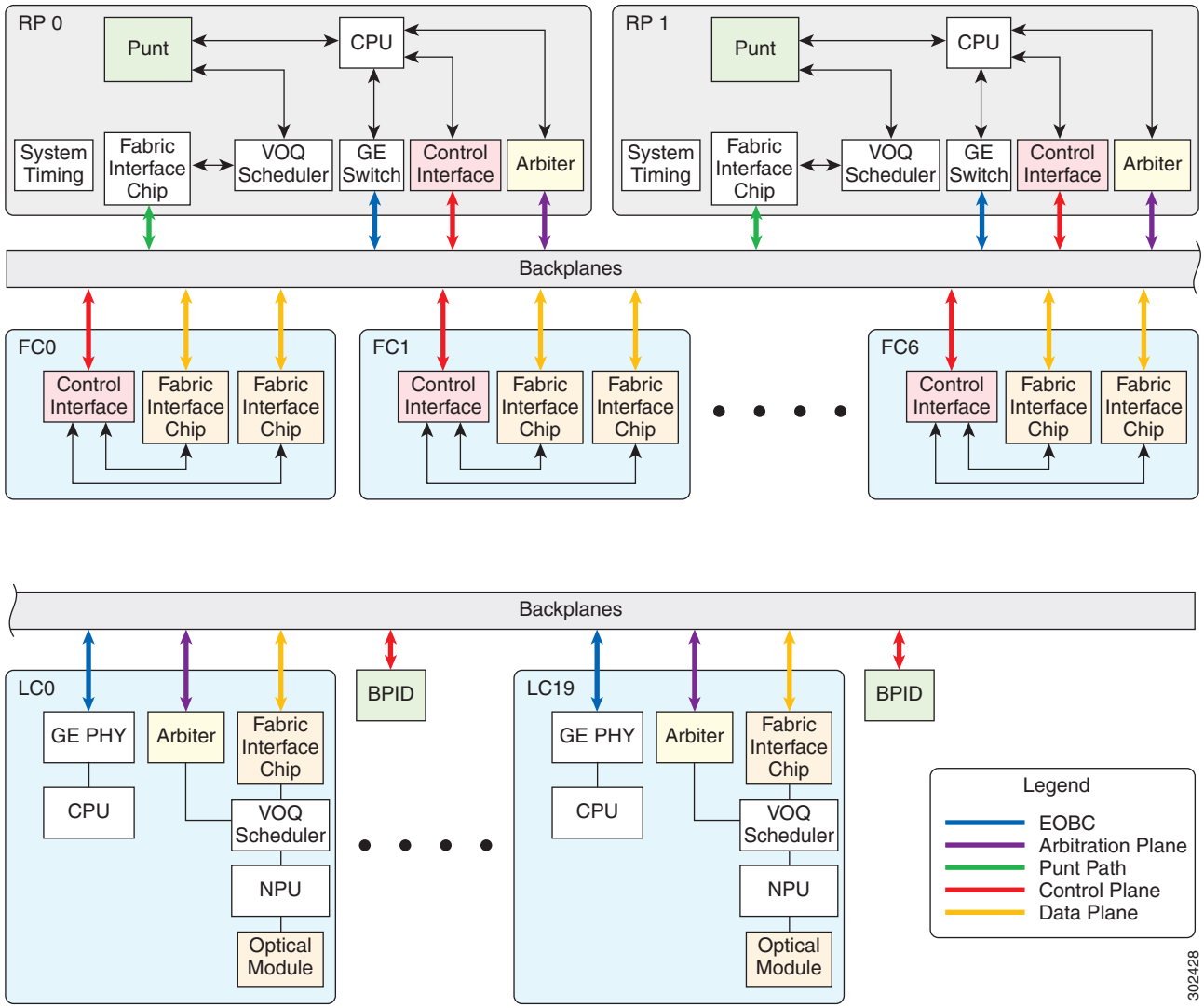


Figure 2-5 Major System Components and Interconnections in the Cisco ASR 9922 Series Router

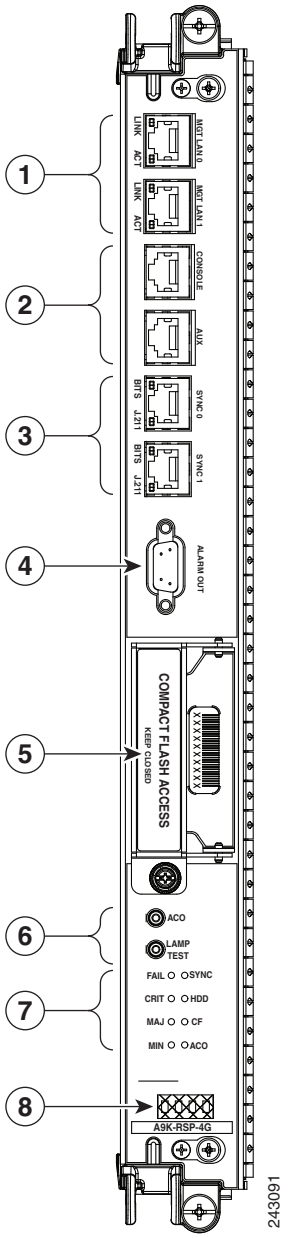


Route Switch Processor Card

The RSP card is the main control and switch fabric element in the Cisco ASR 9010 Router, Cisco ASR 9006 Router, and Cisco ASR 9904 Router chassis. 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 2-6 shows the front panel connectors and indicators of the RSP card.

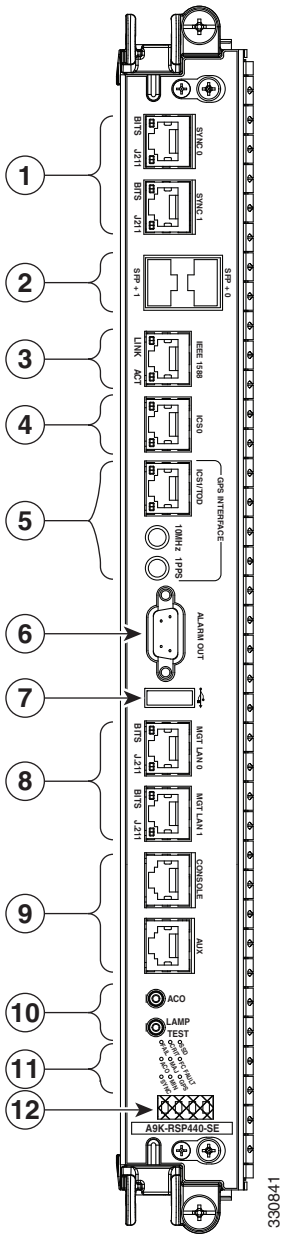
Figure 2-6 RSP Card Front Panel Indicators and Connectors



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

Figure 2-7 shows the front panel of the RSP-440 card.

Figure 2-7 RSP-440 Card Front Panel



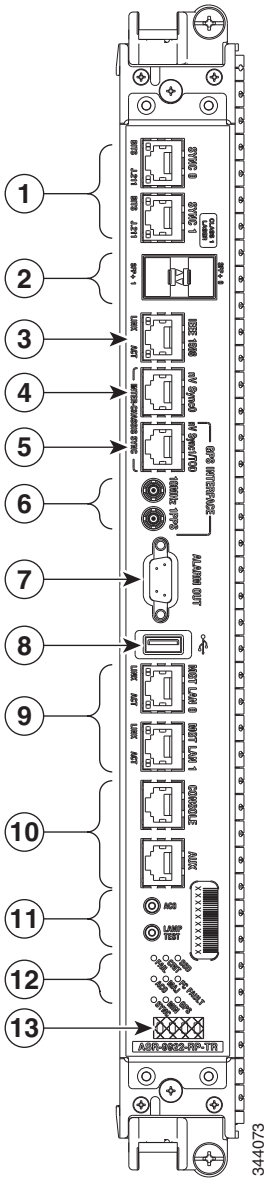
1	SYNC (BITS/J.211) ports	**7**	External USB port
2	SFP ports	**8**	Management LAN ports
3	IEEE 1588 port	**9**	CONSOLE and AUX ports
4	ToD port	**10**	Alarm Cutoff (ACO) and LAMP TEST push buttons
5	10MHz and 1PPS indicators	**11**	Eight discrete LED indicators
6	Alarm Out DB9 connector	**12**	LED matrix display

Route Processor Card

The RP card is the main control element in the Cisco ASR 9922 Router and Cisco ASR 9912 Router chassis. The switch fabric element has been moved to the FC cards. The RP card provides system control, packet switching, and timing control for the system. To provide redundancy, there are two RP cards in the system, one as the active control RP and the other as the standby RP. The standby RP takes over all control functions should the active RP fail.

Figure 2-8 shows the front panel connectors and indicators of the RP card.

Figure 2-8 RP Card Front Panel Connectors and Indicators



1	SYNC (BITS/J.211) ports	**8**	External USB port
2	SFP/SFP+ ports	**9**	Management LAN ports
3	IEEE 1588 port	**10**	CONSOLE and AUX ports
4	Inter-chassis nv Sync0	**11**	Alarm Cutoff (ACO) and Lamp Test push buttons
5	Inter-chassis nv Sync1 GPS ToD	**12**	Nine discrete LED indicators
6	10 MHz and 1 PPS indicators	**13**	LED matrix display
7	Alarm Out DB9 connector		

Front Panel Connectors

This section describes the front panel ports and connectors of the RSP/RP card.

Management LAN Ports

Two dual-speed (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, 2 stop bits with flow control none.

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

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

Synchronization Ports

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/RP 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, 10-Gigabit Ethernet, or SONET interface. The RSP/RP 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 DTI ports. A DOCSIS Timing Interface (DTI) port is used to connect to an external DTI 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.

RP USB Port

The RP card has a single external Universal Serial Bus (USB) port. A USB flash memory device can be inserted to load and transfer software images and files. This memory device can be used to turboboot the system or as the installation source for Package Information Envelopes (PIE) and Software Maintenance Upgrades (SMU). This memory device can also be used for users' data files, core files, and configuration backups.

Front Panel Indicators

The RSP card has eight discrete LED indicators and an LED dot-matrix display for system information. The RSP-440 adds three USB-specific LEDs. The RP has nine discrete LED indicators and an LED dot-matrix display for system information.

Table 2-1 shows the display definitions of the eight discrete LEDs on the RSP front panel and the three RSP-440 specific USB LEDs.

Table 2-1 RSP and RSP-440 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	System timing is synchronized to an external timing source.
	Amber	System timing is free running.
	Off	LED never turns off.

Table 2-1 RSP and RSP-440 Discrete LED Display Definitions (continued)

Indicator (Label)	Color	Description
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.
	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.
External USB 2.0 [RSP-440]	Green	External USB is busy/active.
	Off (Default after reset)	External USB is not busy/active.
Internal USB 2.0 A [RSP-440]	Green	Internal USB is busy/active.
	Off (Default after reset)	Internal USB is not busy/active.
Internal USB 2.0 B [RSP-440]	Green	Internal USB is busy/active.
	Off (Default after reset)	Internal USB is not busy/active.

Table 2-2 lists the display definitions of the nine discrete LEDs on the RP front panel.

Table 2-2 RP Discrete LED Display Definitions

Indicator (Label)	Color	Description
Power Fail (FAIL)	Red (Default after power on)	Standby Power Fail LED. The LED is turned off by the 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.
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.

Table 2-2 RP Discrete LED Display Definitions (continued)

Indicator (Label)	Color	Description
Synchronization (SYNC)	Green	System timing is synchronized to an external timing source including IEEE 1588.
	Amber	System timing is free running.
	Off (Default after reset)	LED never turns off.
Internal Solid State Hard Disk Drive (SSD)	Green	Internal Solid State Hard Disk Drive (SSD0) is busy/active. The LED is driven by the SSD controller.
	Off (Default after reset)	Internal Solid State Hard Disk Drive is not busy/active.
FC Fault	Amber	A fault has occurred on any or all of the FC cards installed. This LED will be on during the boot phase of the FC.
	Off (Default after reset)	FC cards are booted up and ready.
GPS	Green	GPS interface provisioned and ports are turned on. ToD, 1 PPS, 10 Mhz are all valid.
	Off (Default after reset)	Either the interface is not provisioned, or the ports are not turned on. ToD, 1 PPS, and 10 Mhz are not valid.

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

Table 2-3 describes the RSP LED matrix displays of the stages of the boot process and runtime information.

Table 2-4 describes the RSP-440 and RP LED matrix displays of the stages of the boot process and runtime information.

Not all of these messages are seen during a successful boot up process because the screen is updated too quickly for the message to be visible. A failure detected during the boot up process results in the message remaining visible indicating the stage where the boot up process stopped. When possible, the RSP/RP card logs the failure information and reboots.

Table 2-3 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	Starting initialization of memory.
IGEN	Starting initialization of card.
ICBC	Initializing communication with the microcontroller.

Table 2-3 RSP LED Matrix Boot Stage and Runtime Display (continued)

LED Matrix Display	Description
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.

Table 2-4 RSP-440 and RP 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	Starting initialization of memory.
IGEN	Starting initialization of card.
ICBC	Initializing communication with the microcontroller.
SCPI	Board is not plugged in properly.
STID	CBC was unable to read slot ID pins correctly.
PSEQ	CBC detected power sequencer failure.
DBPO	CBC detected an issue during board power up.
KPWR	CBC detected an issue during board power up.
LGNP	CBC detected an issue during board power up.
LGNI	CBC detected an issue during board power up.
RMN	All tests finished and ROMMON is ready for commands.
LOAD	Downloading Minimum Boot Image (MBI) image to CPU.
RRST	ROMMON rebooting board after MBI validation timeout.
MVB	ROMMON trying MBI validation boot.
MBI	Starting execution of MBI.
IOXR	Cisco IOS XR Software is starting execution.
LDG	The RSP/RP is loading (MBI started and card preparing for activity).
INCP	The software or configuration is incompatible with the RSP/RP.
OOSM	The RSP/RP is in Out of Service, Maintenance mode.

Table 2-4 RSP-440 and RP LED Matrix Boot Stage and Runtime Display (continued)

LED Matrix Display	Description
ACT	The RSP/RP is active (IOS-XR completely up and ready for traffic)
STBY	The RSP/RP is standby (IOS-XR completely up and ready)

LED Matrix CAN Bus Controller Error Display

Table 2-5 shows the error messages the LED matrix displays if the RSP card fails one of the power on self tests.

Table 2-5 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/RP 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/RP 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 in the Cisco ASR 9010 Router, Cisco ASR 9006 Router, and Cisco ASR 9904 Router. In the Cisco ASR 9922 Router and Cisco ASR 9912 Router, the route processor functions are on the RP card. whereas the switch fabric is on the FC card. The RSP/RP card also provides shared resources for backplane Ethernet, timing, and chassis control. Redundant RSP/RP 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 line cards together. 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, non-blocking, packet-based, store-and-forward switch. To manage fabric congestion, the RSP card also provides centralized Virtual Output Queue (VOQ) arbitration.

In systems with the RSP card, the switch fabric is capable of delivering 80-Gbps per line card slot. In systems with the RSP-440 card, the switch fabric is capable of delivering 200-Gbps per line card 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.

In the Cisco ASR 9922 Router and Cisco ASR 9912 Router, the switch fabric element has been moved to dedicated FC cards that connect to the backplanes alongside the RP cards. The switch fabric is capable of delivering 550-Gbps per line card slot.

When five FC cards are installed in the chassis, the switch fabric is 4+1 redundant. When all seven FC cards are installed in the chassis, the switch fabric is 6+1 redundant. The switch fabric is fully redundant, with one copy of the fabric on each FC, and each FC carries enough switching capacity to meet the chassis throughput specifications.

Figure 2-9 shows the switch fabric interconnections.

Figure 2-9 Switch Fabric Interconnections

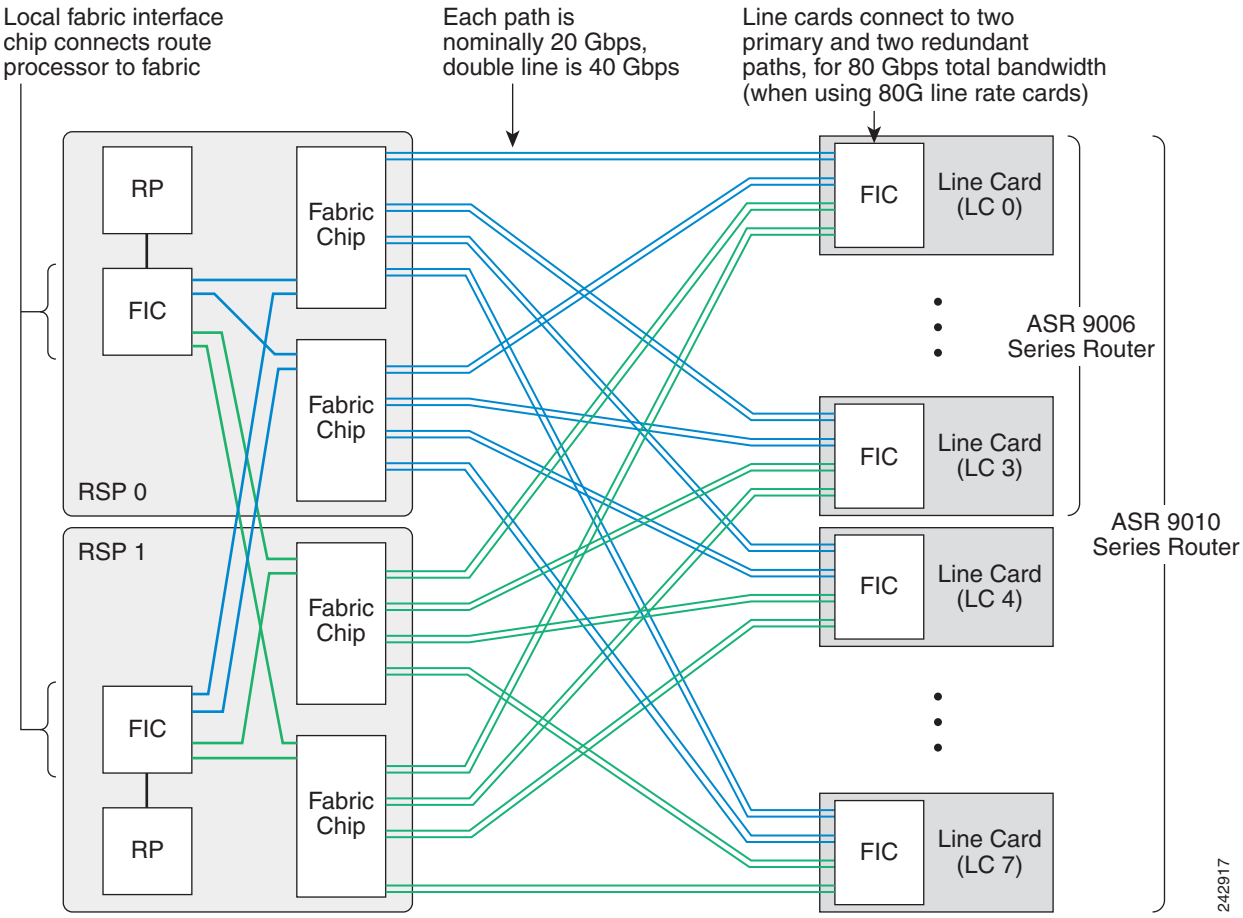
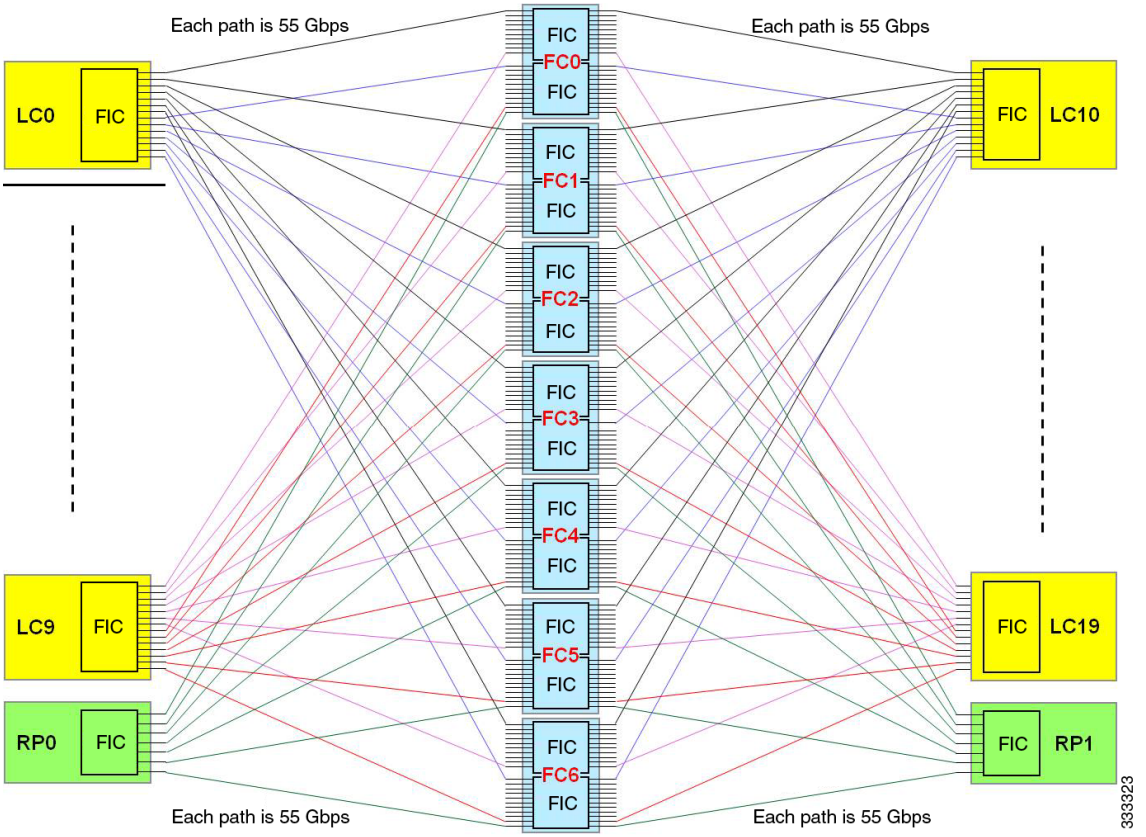


Figure 2-10 shows the Cisco ASR 9922 Router switch fabric.

Figure 2-10 Cisco ASR 9922 Router Switch Fabric



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/RP cards.

Multicast Traffic

Multicast traffic is replicated in the switch fabric. For multicast (including unicast floods), the Cisco ASR 9000 Series Routers replicate 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 64-K Fabric Multicast Groups (RSP 2-based line cards) or 128-K Fabric Multicast Groups (RSP 440-based line cards) 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 is 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 performs the ordinary chassis management functions. The ASR 9000 Series Routers run Cisco IOS XR software, so the Route Processor runs the centralized portions of the software for chassis control and management.

Secondary functions of the Route Processor include boot media, system timing (frequency and time of date) synchronization, precision clock synchronization, backplane Ethernet communication, and power control (through a separate CAN bus controller network).

The Route Processor communicates with other route processors and linecards over a switched Ethernet out-of-band channel (EOBC) for management and control purposes.

Figure 2-11 shows the route processor interconnections on the RSP.

Figure 2-12 shows the component interconnections on the RP.

Figure 2-13 shows the component interconnections on the FC.

Figure 2-11 Route Processor Interconnections

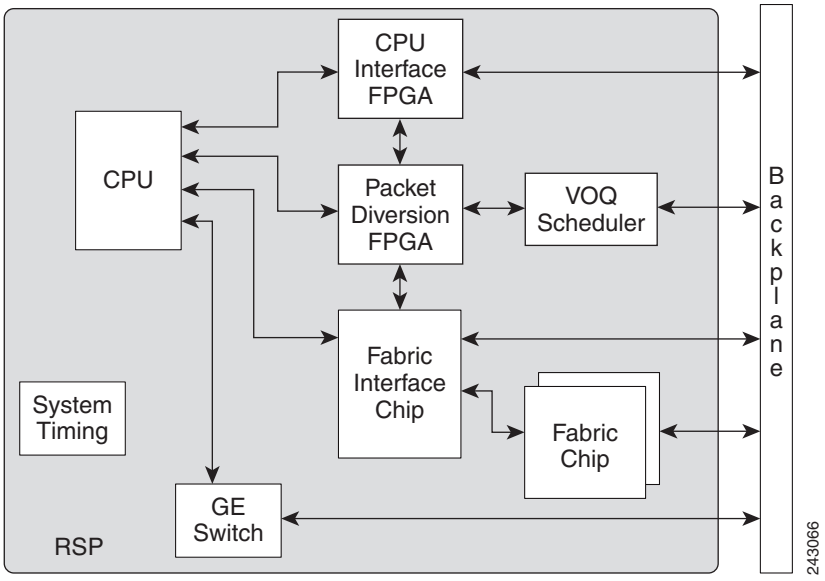


Figure 2-12 RP Component Interconnections

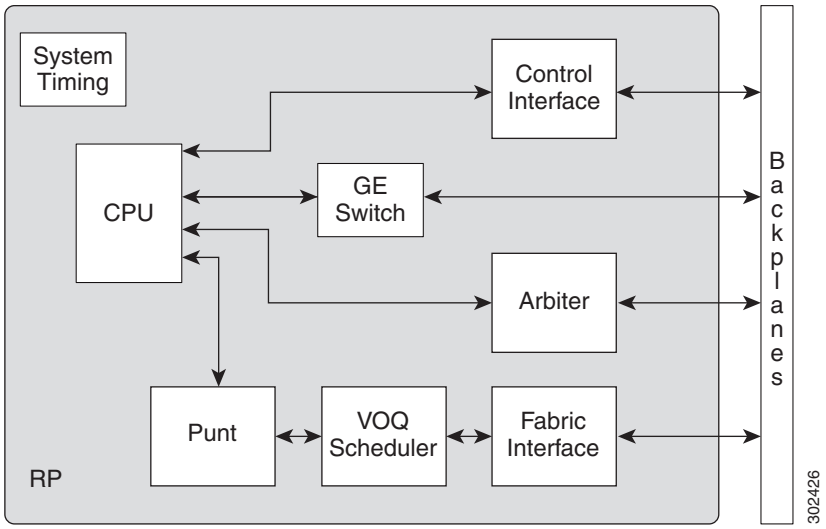
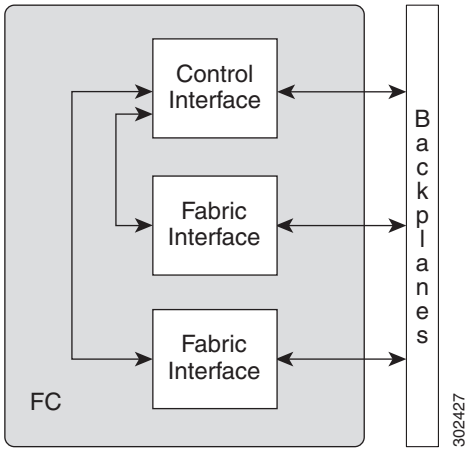


Figure 2-13 FC Component Interconnections



Processor-to-Processor Communication

The RSP/RP 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/RP card also uses the EOBC to communicate to the Standby RSP/RP card, if installed.

Route Processor/Fabric Interconnect

The RSP card has a fabric interface chip (FIC) attached to the switch 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.

The Route Processor communicates with the switch fabric via a FIC to process control traffic. The FIC has sufficient bandwidth to handle the control traffic and flow control in the event of fabric congestion. External traffic is diverted to the Route Processor by the line card network processors.

The RP and FC cards in the Cisco ASR 9922 Router have control interface chips and FICs attached to the backplanes that provide control plane and punt paths.

Fabric Controller Card

On the Cisco ASR 9922 Router and Cisco ASR 9912 Router, the switch fabric has been moved to FC cards.

The switch fabric is configured as a single stage of switching with multiple parallel planes. The switch fabric is responsible for transporting packets from one line card to another but has no packet processing capabilities. Each fabric plane is a single-stage, non-blocking, packet-based, store-and-forward switch. To manage fabric congestion, the RP provides centralized Virtual Output Queue (VOQ) arbitration.

The switch fabric is capable of delivering 550-Gbps per line card slot. When five FC cards are installed in the chassis, the switch fabric is 4+1 redundant. When all seven FC cards are installed in the chassis, the switch fabric is 6+1 redundant. The switch fabric is fully redundant, with one copy of the fabric on each FC, and each FC carries enough switching capacity to meet the chassis throughput specifications.

Figure 2-14 shows the FC card.

Figure 2-14 FC Card

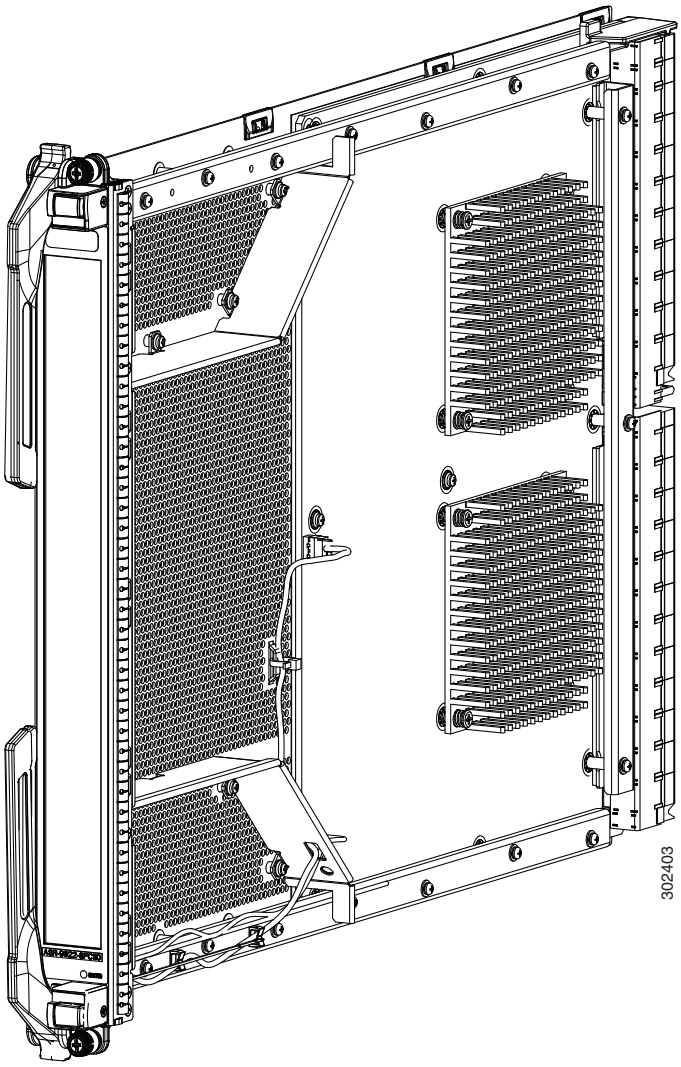
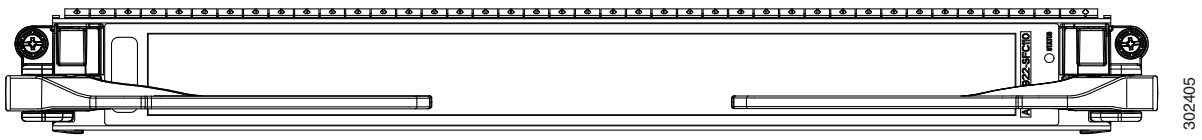


Figure 2-15 shows the front panel of the FC card. The front panel has a status LED, ejector levers, ejector lever release buttons, and mounting screws.

Figure 2-15 FC Card Front Panel



FC Card Front Panel Indicator

The front panel of the FC card has one tri-color LED indicator for system information.

Table 2-6 lists the display definitions of the discrete LED on the FC card front panel.

Table 2-6 FC Card LED Display Definitions

Indicator (Label)	Color	Description
Power Fail (FAIL)	Green	FC card powered on and FPGA is programmed. **Note** Fabric Data Link failure is not detected so LED remains green. Monitor CLI messages for status.
	Red	Fault or malfunction in FC card power up or FPGA programming. **Note** Once any ejector lever release button is pushed in, the FC card must be physically removed and reinserted (OIR) to restart the FC card. During this time before the FC card is restarted, the LED is red.
	Amber	FC card powered on but fabric not active.
	Off (Default after reset)	FC card powered off via CLI.

Ethernet Line Cards

Table 2-7 lists the Ethernet line cards available for the Cisco ASR 9000 Series Routers.

Table 2-7 Ethernet Line Cards Available for the Cisco ASR 9000 Series Routers

Line Card	Module Type
40-port Gigabit Ethernet (40x1GE) line card	SFP[1]
8-port 10-Gigabit Ethernet (8x10GE) 2:1 oversubscribed line card	XFP[2]
4-port 10-Gigabit Ethernet (4x10GE) line card	XFP
8-port 10-Gigabit Ethernet (8x10GE) 80G line rate card	XFP
2-port 10-Gigabit Ethernet plus 20-port Gigabit Ethernet (2x10GE + 20x1GE) combination line card	XFP for 10GE ports SFP for 1GE ports
16-port 10-Gigabit Ethernet (16x10GE) oversubscribed line card	SFP+[3]
24-port 10-GE DX Line Card, Packet Transport Optimized Requires SFP+ Modules	SFP+
24-port 10-GE DX Line Card, Service Edge Optimized Requires SFP+ Modules	SFP+
36-port 10-GE DX Line Card, Packet Transport Optimized Requires SFP+ Modules	SFP+
36-port 10-GE DX Line Card, Service Edge Optimized Requires SFP+ Modules	SFP+
2-port 100-GE DX Line Card, Packet Transport Optimized Requires CFP Modules	CFP[4]

Table 2-7 Ethernet Line Cards Available for the Cisco ASR 9000 Series Routers (continued)

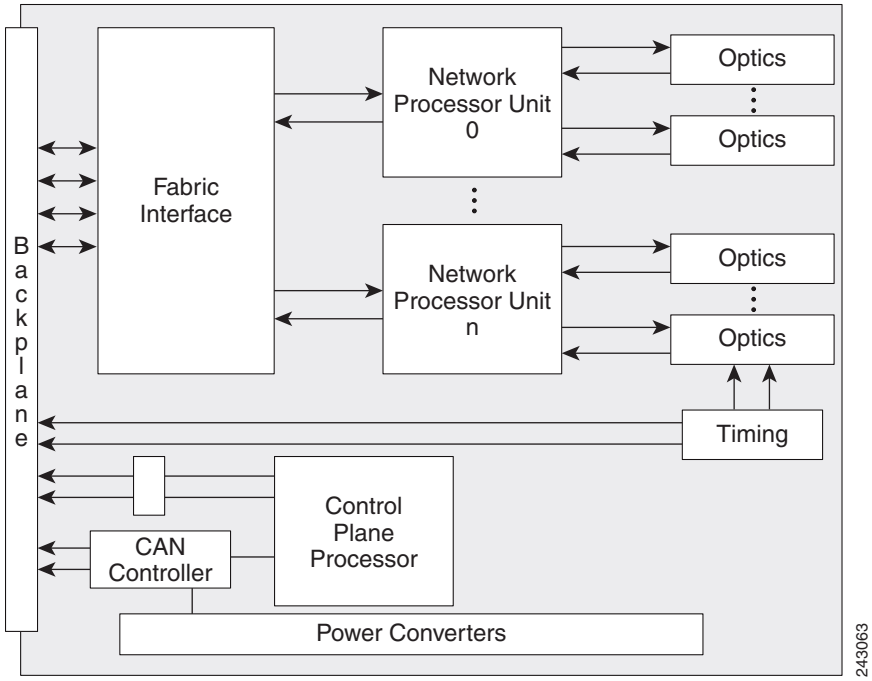
Line Card	Module Type
2-port 100-GE DX Line Card, Service Edge Optimized Requires CFP Modules	CFP
1-port 100-GE DX Line Card, Packet Transport Optimized Requires CFP Modules	CFP
1-port 100-GE DX Line Card, Service Edge Optimized Requires CFP Modules	CFP
80 Gigabyte Modular Line Card, Packet Transport Optimized	N/A
80 Gigabyte Modular Line Card, Service Edge Optimized	N/A
160 Gigabyte Modular Line Card, Packet Transport Optimized	N/A
160 Gigabyte Modular Line Card, Service Edge Optimized	N/A
20-port GE Modular Port Adapter (MPA)	SFP
8-port 10-GE MPA	SFP+
4-port 10-GE MPA	XFP
2-port 10-GE MPA	XFP
2-port 40-GE MPA	QSFP+[5]
1-port 40-GE MPA	QSFP+[6]

1. SFP = Gigabit Ethernet small form-factor pluggable transceiver module
2. XFP = 10-Gigabit Ethernet small form-factor pluggable transceiver module
3. SFP+ = 10-Gigabit Ethernet small form-factor pluggable transceiver module
4. CFP = 100-Gigabit Ethernet small form-factor pluggable transceiver module
5. QSFP+ = 40-Gigabit Ethernet quad small form-factor pluggable transceiver module
6. QSFP+ = 40-Gigabit Ethernet quad small form-factor pluggable transceiver module

Functional Description

Ethernet line cards for the Cisco ASR 9000 Series Routers provide forwarding throughput of line rate for packets as small as 64 bytes. The small form factor pluggable (SFP, SFP+, QSFP+, XFP, or CFP) 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 (see Figure 2-16).

Figure 2-16 General Line Card Data Plane Block Diagram



Most of the line cards have four NPUs per card (the 80-G line rate card has eight). The 2-port 100GE DX line card has eight NPUs per card, while the 2-port 100GE DX line card, the 80-gigabyte modular line card, the 160-gigabyte modular line card, and the modular port adapters (MPAs) they support 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/RP fabric. This path handles all main data and also control data that are routed to the RSP/RP 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/RP card through the fabric link.

The backplane Gigabit Ethernet links, one to each RSP/RP 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 3.3 V regulator uses 10 V 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 16 KB, and the bridge FPGA and fabric interface chip have been designed to handle a frame size of 10 KB.

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/RP 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/RP 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/RP 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).

40-Port Gigabit Ethernet (40x1GE) Line Card

The 40-port Gigabit Ethernet (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 connects to one NPU through an SGMII serial bus interface.

The 40x1GE line card is available in base, extended, and low-queue versions. All versions are functionally equivalent, with the extended version of the line card providing typically twice the service scale of the base line card.

Figure 2-17 shows a block diagram for the 40x1GE line card, and Figure 2-18 shows the front panel connectors and indicators.

Figure 2-17 40-Port Gigabit Ethernet (40x1GE) Line Card Block Diagram

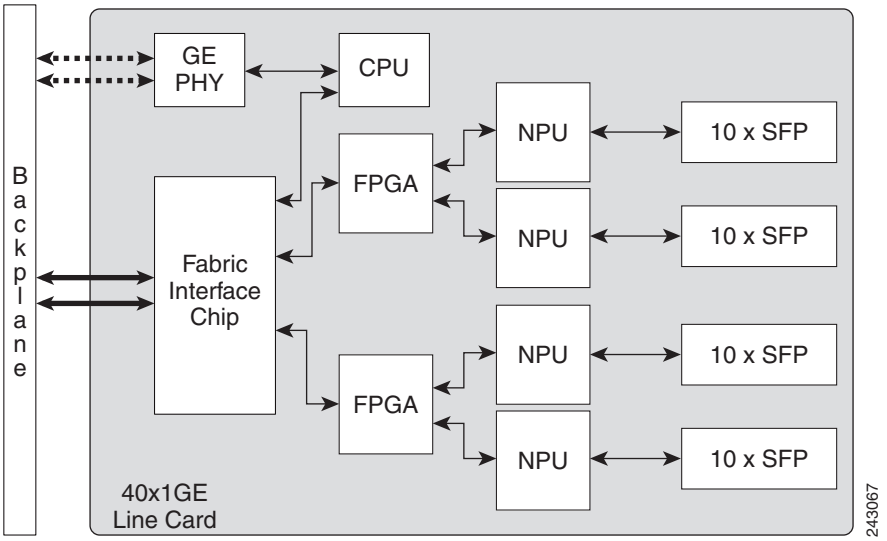
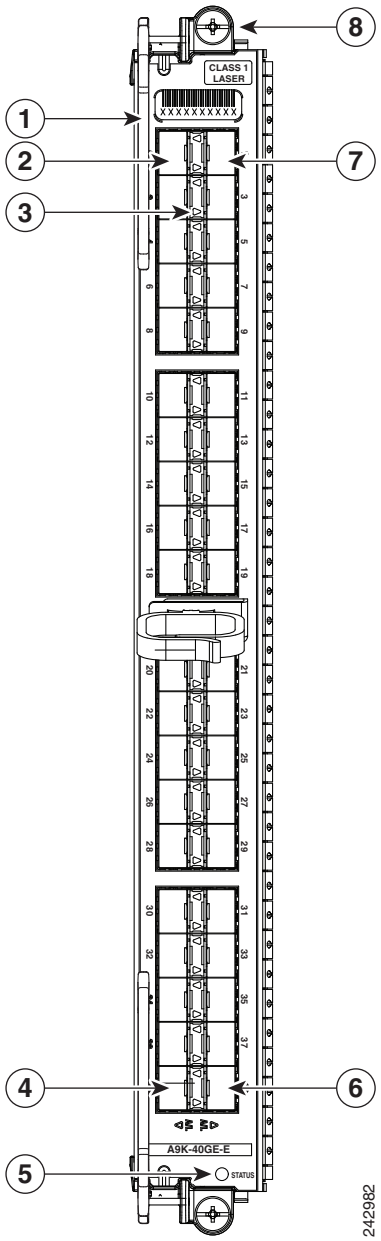


Figure 2-18 40-Port Gigabit Ethernet (40x1GE) Line Card Front Panel



1	Ejector lever (one of two)	**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 (one of two)

8-Port 10-Gigabit Ethernet (8x10GE) 2:1 Oversubscribed Line Card

The 8-port 10-Gigabit Ethernet (8x10GE) 2:1 oversubscribed 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.

The 8x10GE 2:1 oversubscribed line card is available in base, extended, and low-queue versions. All versions are functionally equivalent, with the extended version of the line card providing typically twice the service scale of the base line card.

Figure 2-19 shows the block diagram for the 8x10GE 2:1 oversubscribed line card, and Figure 2-20 shows the front panel connectors and indicators.

Figure 2-19 8-Port 10-Gigabit Ethernet (8x10GE) 2:1 Oversubscribed Line Card Block Diagram

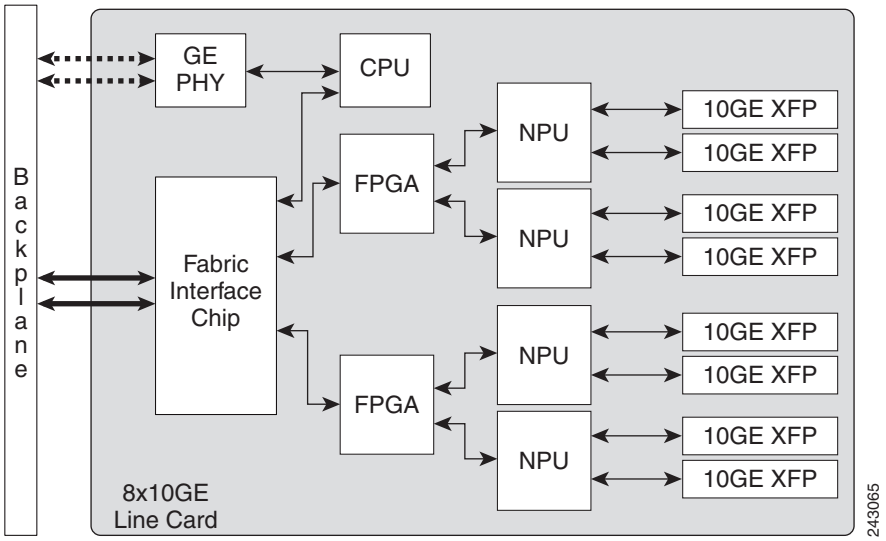
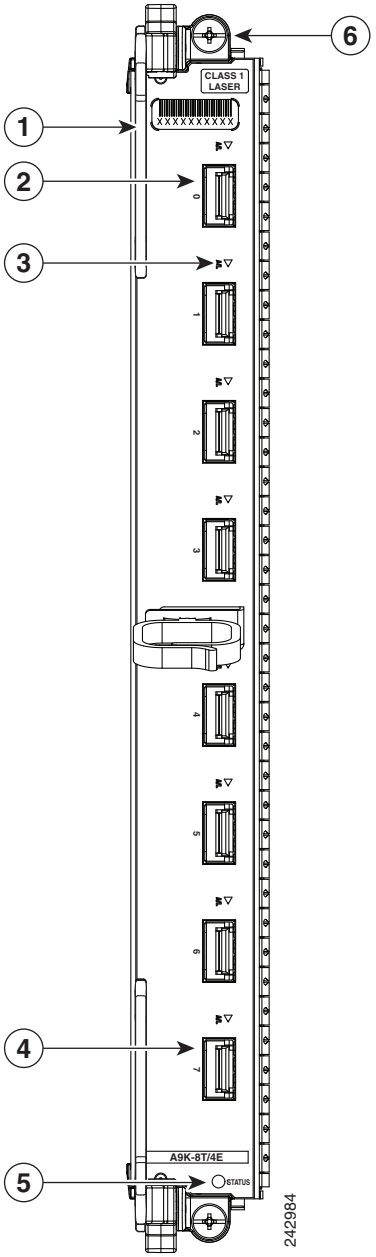


Figure 2-20 8-Port 10-Gigabit Ethernet (8x10GE) 2:1 Oversubscribed Line Card Front Panel



1	Ejector lever (one of two)	**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 (one of two)

4-Port 10-Gigabit Ethernet (4x10GE) Line Card

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

The 4x10GE line card is available in base, extended, and low-queue versions. All versions are functionally equivalent, with the extended version of the line card providing typically twice the service scale of the base line card.

Figure 2-21 shows the block diagram for the 4x10GE Line card, and Figure 2-22 shows the front panel connectors and indicators.

Figure 2-21 4-Port 10-Gigabit Ethernet (4x10GE) Line Card Block Diagram

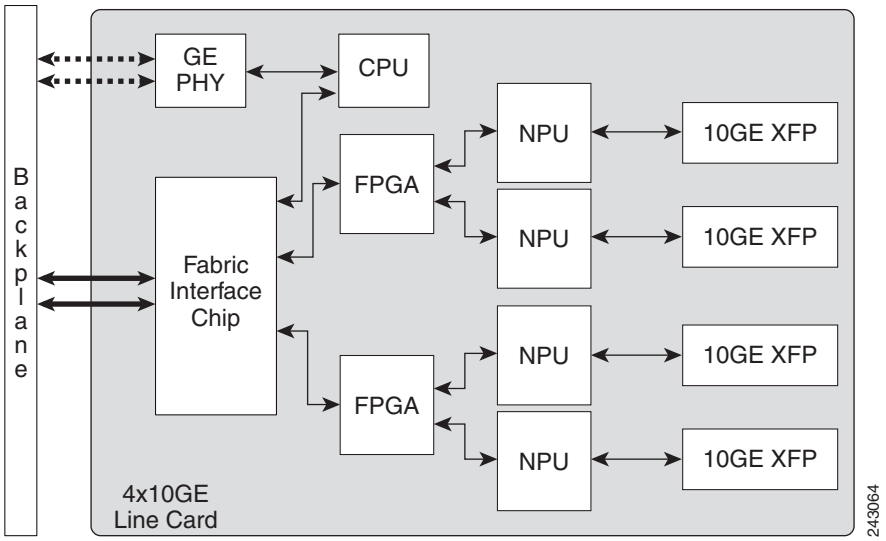
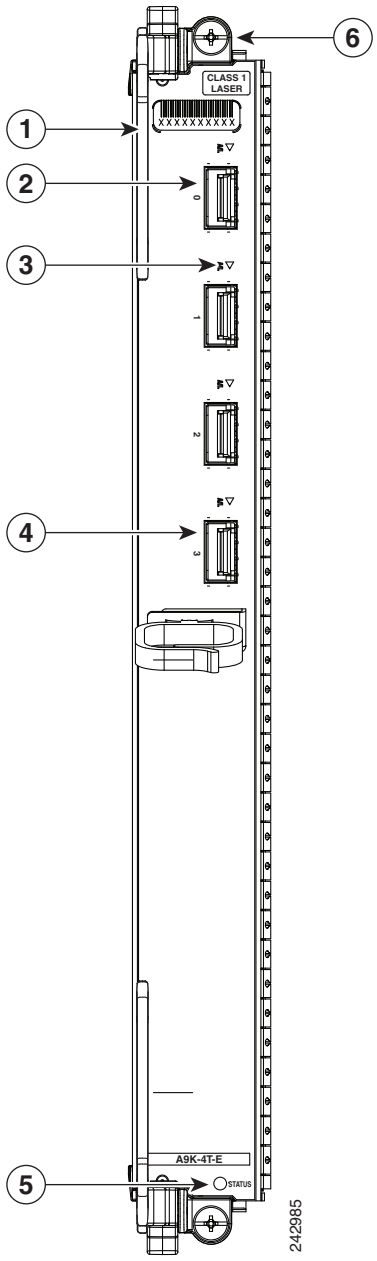


Figure 2-22 4-Port 10-Gigabit Ethernet (4x10GE) Line Card Front Panel



1	Ejector lever (one of two)	**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 (one of two)

8-port 10-Gigabit Ethernet (8x10GE) 80-Gbps Line Rate Card

The 8-port 10-Gigabit Ethernet (8x10GE) 80-Gbps line rate card has eight 10-Gigabit Ethernet XFP module ports. One 10-Gigabit Ethernet port connects to an XAUI interface on each of the eight NPUs. The 8x10GE 80-Gbps line rate card supports WAN PHY and OTN modes as well as the default LAN mode.

The 8x10GE 80-Gbps line rate card is available in base, extended, and low-queue versions. All versions are functionally equivalent, with the extended version of the line card providing typically twice the service scale of the base line card.

Figure 2-23 shows the block diagram for the 8x10GE 80-G line rate card, and Figure 2-24 shows the front panel connectors and indicators.

Figure 2-23 8-Port 10-Gigabit Ethernet (8x10GE) 80-Gbps Line Rate Card Block Diagram

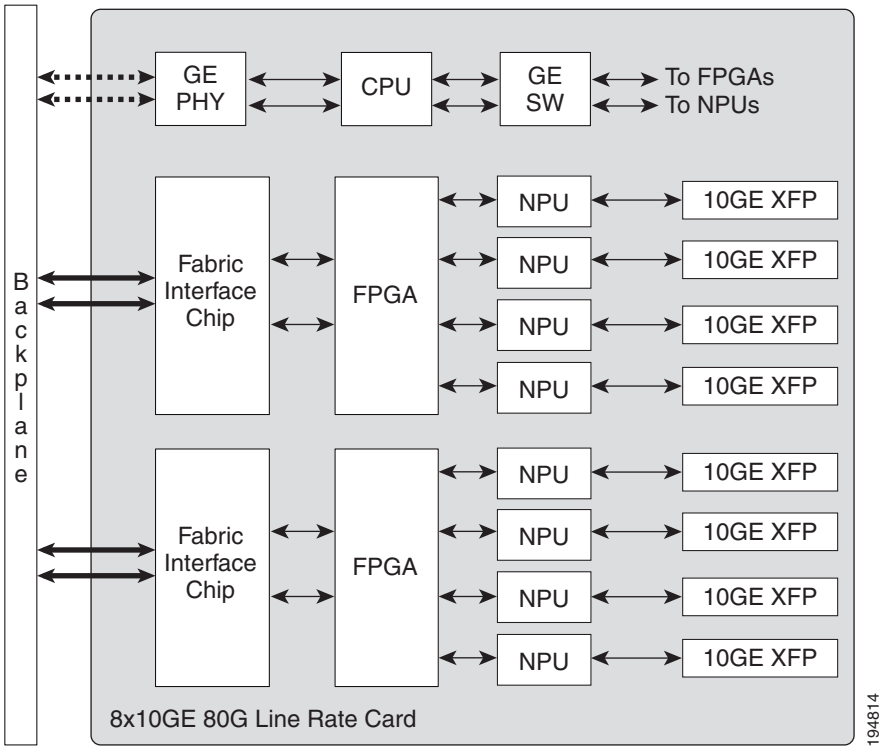
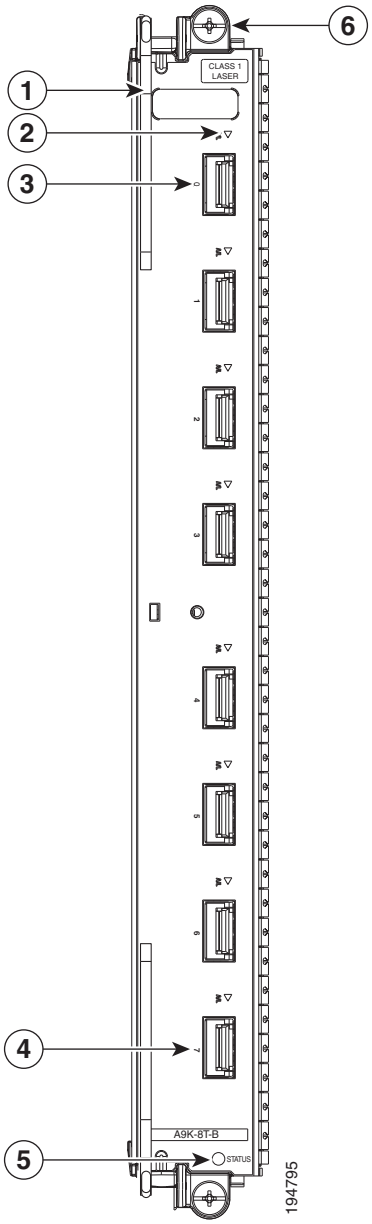


Figure 2-24 8-Port 10-Gigabit Ethernet (8x10GE) 80-Gbps Line Rate Card Front Panel



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

2-Port 10-Gigabit Ethernet + 20-port 1-Gigabit Ethernet (2x10GE + 20x1GE) Combination Line Card

The 2-port 10-Gigabit Ethernet + 20-port 1-Gigabit Ethernet (2x10GE + 20x1GE) combination line card has two 10-Gigabit Ethernet XFP module ports and 20 Gigabit Ethernet SFP module ports. Each port (XFP or SFP) connects to an XAUI interface on one of the four NPUs. The 2x10GE + 20x1GE combination line card supports WAN PHY and OTN modes as well as the default LAN mode.

The 2x10GE + 20x1GE combination line card is available in base, extended, and low-queue versions. All versions are functionally equivalent, with the extended version of the line card providing typically twice the service scale of the base line card.

Figure 2-25 shows the block diagram for the 2x10GE + 20x1GE combination line card, and Figure 2-26 shows the front panel connectors and indicators.

Figure 2-25 2-Port 10-Gigabit Ethernet + 20-Port Gigabit Ethernet (2x10GE + 20x1GE) Combination Line Card Block Diagram

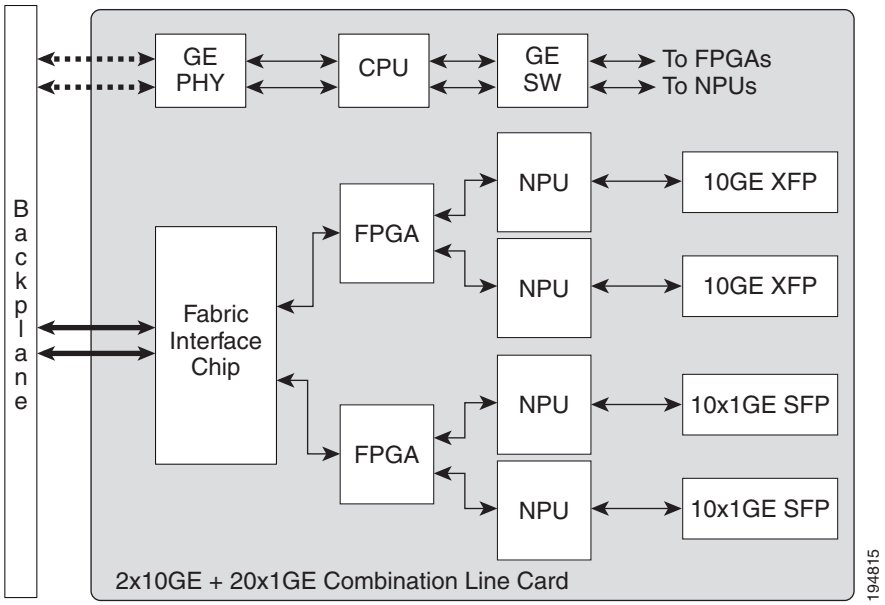
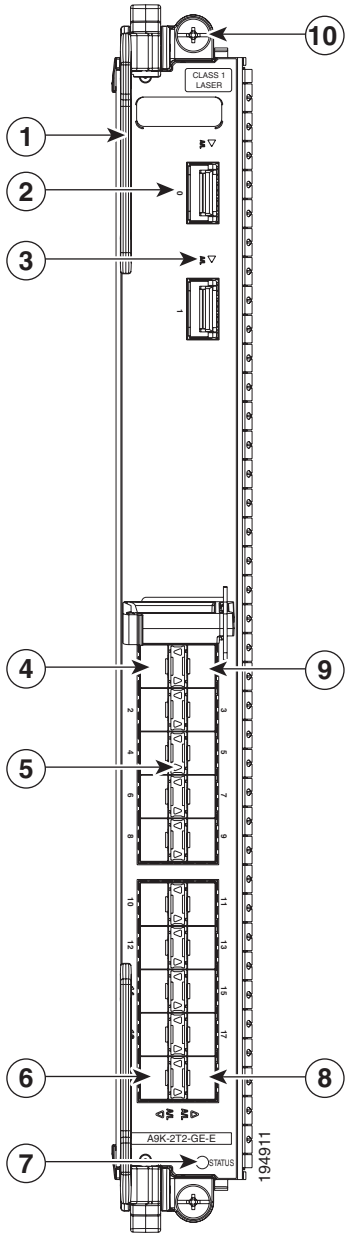


Figure 2-26 2-port 10-Gigabit Ethernet + 20-Port 1-Gigabit Ethernet (2x10GE + 20x1GE) Combination Line Card Front Panel



1	Ejector lever (one of two)	**6**	1GE Port 18 SFP cage
2	10GE Port 0 XFP cage	**7**	Line Card Status LED
3	XFP Port Status LED (one per XFP port)	**8**	1GE Port 19 SFP cage
4	1GE Port 0 SFP cage	**9**	1GE Port 1 SFP cage
5	SFP Port Status LED (one per SFP port)	**10**	Captive installation screw (one of two)

16-port 10-Gigabit Ethernet (16x10GE) Oversubscribed Line Card

The 16-port 10-Gigabit Ethernet (16x10GE) oversubscribed line card has sixteen 10-Gigabit Ethernet, oversubscribed, SFP+ (10-Gigabit Ethernet SFP) module ports. Two 10-Gigabit Ethernet ports connect to XAUI interfaces on each of the eight NPUs.

The 16x10GE oversubscribed line card is available in a base version.

Figure 2-27 shows the block diagram for the 16x10GE oversubscribed line card, and Figure 2-28 shows the front panel connectors and indicators.

Figure 2-27 16x10GE Oversubscribed Line Card Block Diagram

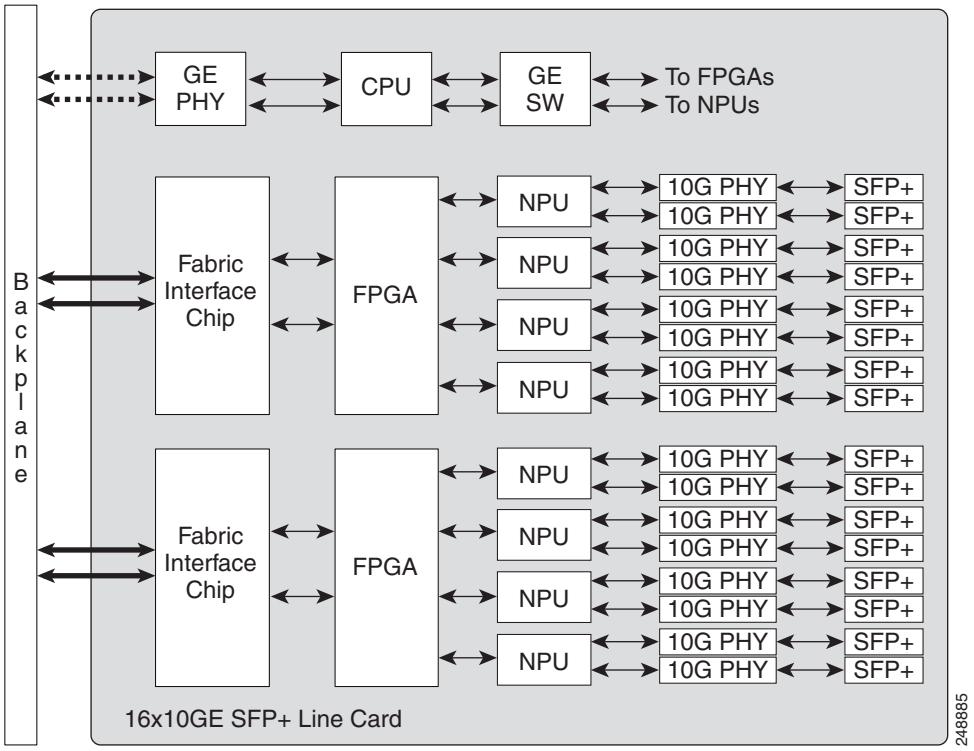
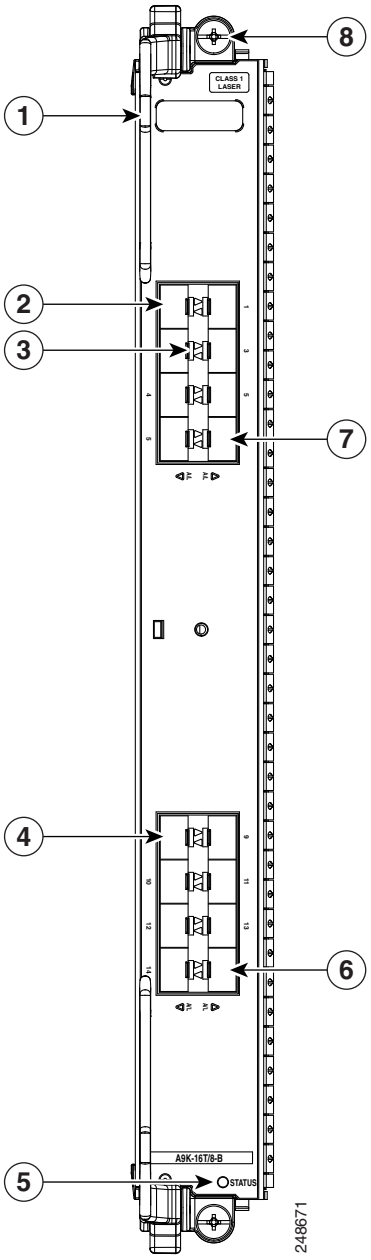


Figure 2-28 16-Port 10-Gigabit Ethernet (16x10GE) Oversubscribed Line Card Front Panel



1	Ejector lever (one of two)	**5**	Line Card Status LED
2	Port 0 SFP+ cage	**6**	Port 15 SFP+ cage
3	Port Status LED (one per port)	**7**	Port 7 SFP+ cage
4	Port 8 SFP+ cage	**8**	Captive installation screw (one of two)

24-Port 10-Gigabit Ethernet Line Card

The 24-port 10-Gigabit Ethernet line card provides two stacked 2x6 cage assemblies for SFP+ Ethernet optical interface modules. The 24 SFP+ modules operate at a rate of 10-Gbps.

With two RSP cards installed in the router, the 24-port 10-Gigabit Ethernet line card runs at line rate.

With a single RSP card installed in the router, the 24-port 10-Gigabit Ethernet line card is a 220-Gbps line rate card.

The 24-port 10-Gigabit Ethernet line card is available in either an -SE (Service Edge Optimized) or -TR (Packet Transport Optimized) version.

Each SFP+ cage on the 24-port 10-Gigabit Ethernet line card has an adjacent Link LED visible on the front panel. The Link LED indicates the status of the associated SFP+ port.

Figure 2-29 shows the front panel and connectors of the 24-port 10-Gigabit Ethernet line card.

Figure 2-29 24-Port 10-Gigabit Ethernet Line Card

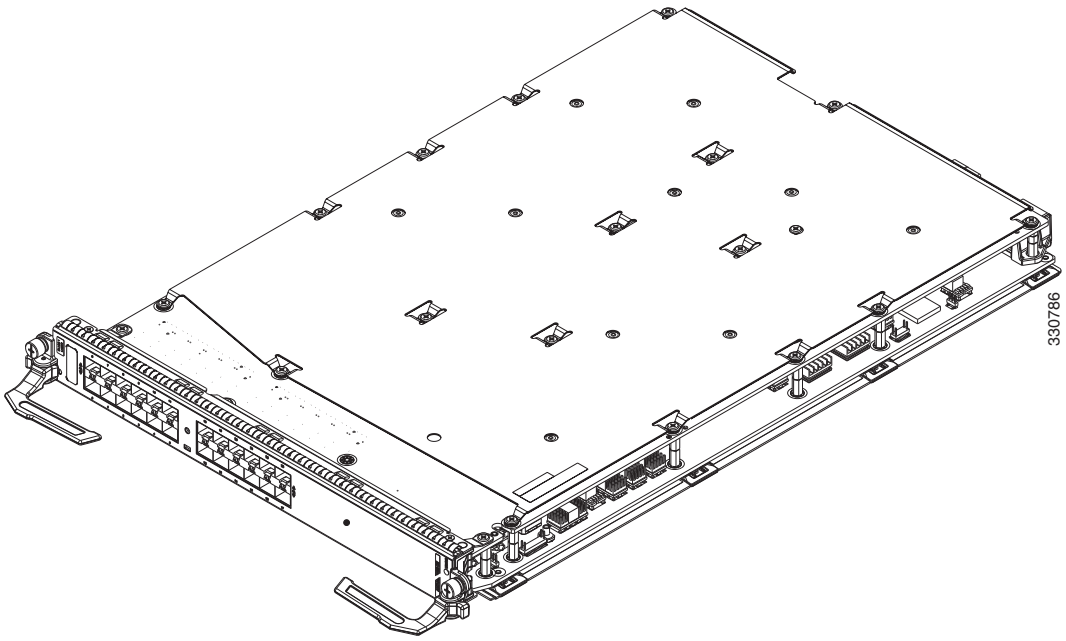
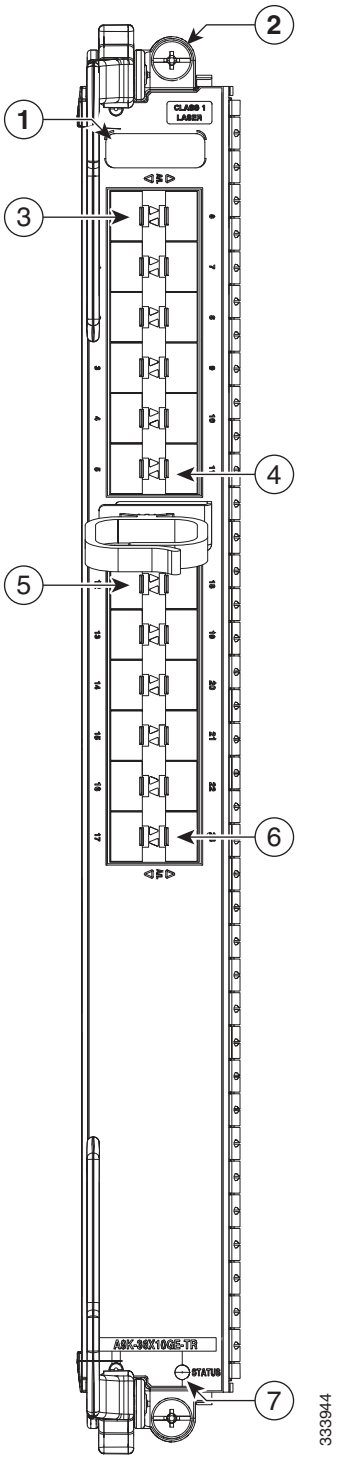


Figure 2-30 24-port 10-Gigabit Ethernet (24x10GE) Line Card Front Panel



1	Ejector lever (one of two)	**5**	Port 12 SFP+ cage
2	Captive installation screw (one of two)	**6**	Port 23 SFP+ cage
3	Port 0 SFP+ cage	**7**	Line Card Status LED
4	Port 11 SFP+ cage		

36-port 10-Gigabit Ethernet Line Card

The 36-port 10-Gigabit Ethernet line card provides three stacked 2x6 cage assemblies for SFP+ Ethernet optical interface modules. The 36 SFP+ modules operate at a rate of 10-Gbps.

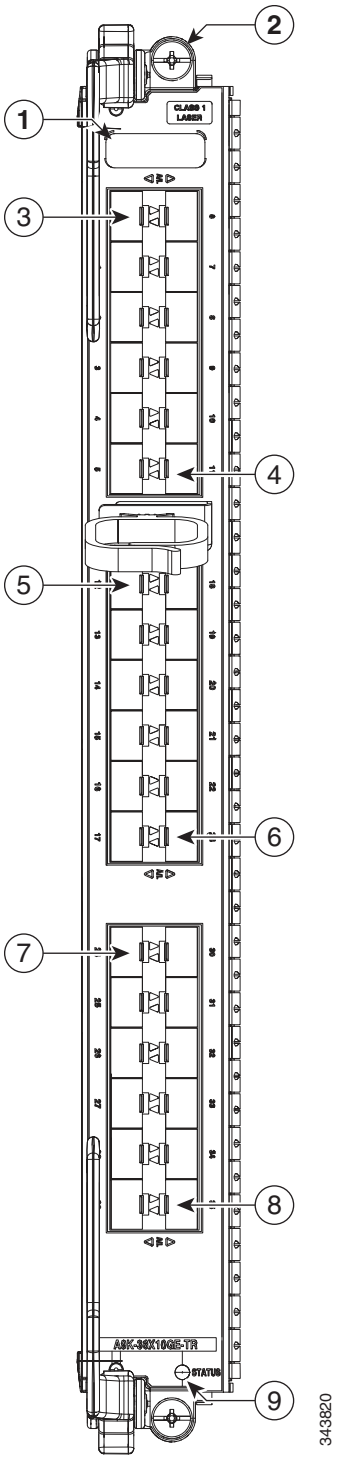
The card consists of two boards: a motherboard and a daughter board. Major components on the motherboard include two Network Processors, a CPU, and ASICs. Major components on the daughter board include four Network Processors, two ASICs, six Hex Phys, and three 2x6 SFP+ cages.

With two RP cards installed in the Cisco ASR 9922 Router, the 36-port10-Gigabit Ethernet line card runs at line rate. With a single RP card installed in the Cisco ASR 9922 Router, the 36-port 10-Gigabit Ethernet line card is a 220-Gbps line rate card.

The 36-port 10-Gigabit Ethernet line card is available in either an -SE (Service Edge Optimized) or -TR (Packet Transport Optimized) version. Both versions are functionally equivalent but vary in configuration scale and buffer capacity.

Figure 2-31 shows the front panel connectors and indicators of the 36-port 10-GE line card.

Figure 2-31 36-Port 10-Gigabit Ethernet (36x10GE) Line Card Front Panel



1	Ejector lever (one of two)	**6**	Port 23 SFP+ cage
2	Captive installation screw (one of two)	**7**	Port 24 SFP+ cage
3	Port 0 SFP+ cage	**8**	Port 35 SFP+ cage
4	Port 11 SFP+ cage	**9**	Line Card Status LED
5	Port 12 SFP+ cage		

2-port 100-Gigabit Ethernet Line Card

The 2-port 100-GE line card provides two CFP cages for CFP Ethernet optical interface modules that operate at a rate of 100-Gbps.

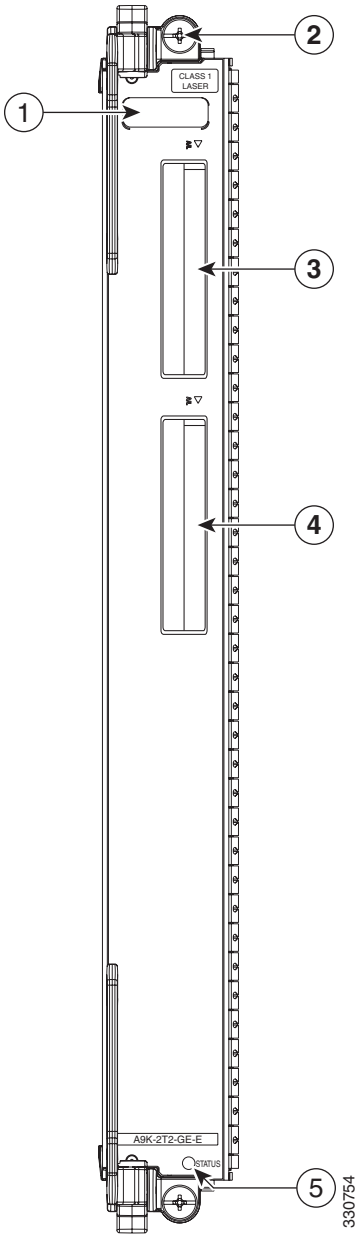
The two CFP modules can be100-Gigabit Ethernet multimode connections.

The 2-port 100-GE line card is available in either an -SE (Service Edge Optimized) or -TR (Packet Transport Optimized) version. Both versions are functionally equivalent, but vary in configuration scale and buffer capacity.

Each CFP cage on the 2-port 100-GE line card has an adjacent Link LED visible on the front panel. The Link LED indicates the status of the associated CFP port.

Figure 2-32 shows the front panel and connectors of the 2-port 100-GE line card.

Figure 2-32 2-Port 100-Gigabit Ethernet (2x100GE) Line Card Front Panel



1	Ejector lever (one of two)	**4**	100-GE CFP connector (two of two)
2	Captive installation screw (one of two)	**5**	Line Card Status LED
3	100-GE CFP connector (one of two)		

1-Port 100-Gigabit Ethernet Line Card

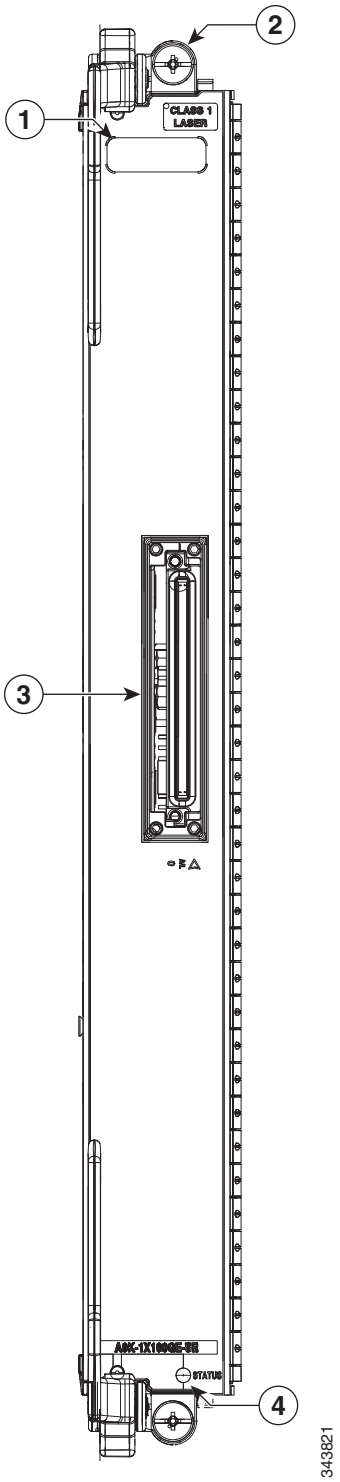
The 1-port 100-GE line card provides one CFP cage for a CFP Ethernet optical interface module that operates at a rate of 100-Gbps. The CFP module can be a 100-Gigabit Ethernet multimode connection.

The 1-port 100-GE line card is available in either an -SE (Service Edge Optimized) or -TR (Packet Transport Optimized) version. Both versions are functionally equivalent, but vary in configuration scale and buffer capacity.

The CFP cage has an adjacent Link LED visible on the front panel. The Link LED indicates the status of the CFP port.

Figure 2-33 shows the front panel of the 1-port 100-GE line card.

Figure 2-33 1-Port 100-Gigabit Ethernet (1x100GE) Line Card Front Panel



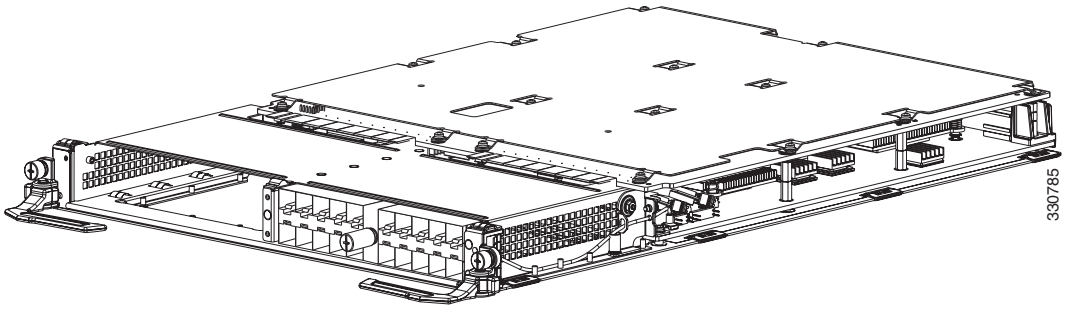
1	Ejector lever (one of two)	**3**	100-GE Port
2	Captive installation screw (one of two)	**4**	Line Card Status LED

Modular Line Cards

The modular line card is available in two network processing unit (80-gb throughput) and in four network processing unit (160-gb throughput) versions. Each version is available in either a Service Edge Optimized (-SE) or Packet Transport Optimized (-TR) version. Both versions are functionally equivalent, but vary in configuration scale and buffer capacity.

Figure 2-34 shows a modular line card with a 20-port Gigabit Ethernet modular port adapter (MPA) installed in the lower bay. As shown in Figure 2-34, Bay 0 is the "upper" or "left" bay, and Bay 1 is the "lower" or "right" bay.

Figure 2-34 Modular Line Card



The MPA has Active/Link (A/L) LEDs visible on the front panel. Each A/L LED shows the status of both the port and the link. A green A/L LED means the state is on, the port is enabled, and the link is up. An amber A/L LED means the state is on, the port is enabled, and the link is down. An A/L LED that is off means the state is off, the port is not enabled, and the link is down.

The modular line card provides two bays that support the following MPAs:

- 20-port GE MPA
- 8-port 10-GE MPA
- 4-port 10-GE MPA
- 2-port 10-GE MPA
- 2-port 40-GE MPA
- 1-port 40-GE MPA

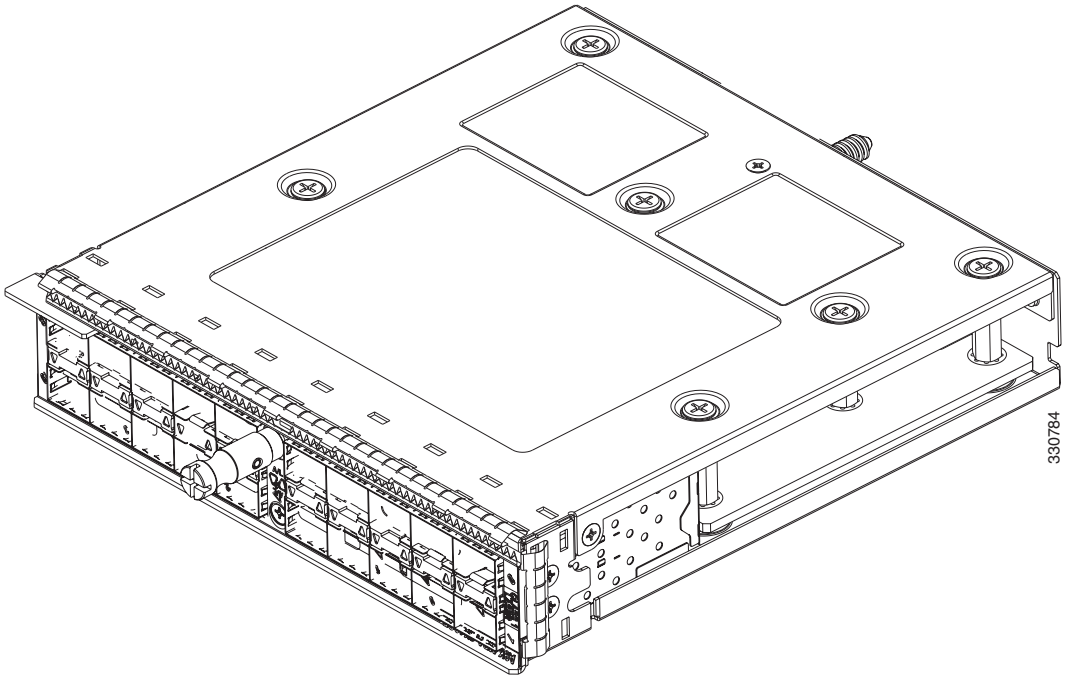
20-port Gigabit Ethernet Modular Port Adapter

The 20-port Gigabit Ethernet MPA provides 10 double-stacked SFP (20 total) cages that support either fiber-optic or copper Gigabit Ethernet transceivers. It also supports copper SFP modules with 10/100-1000 Mbps speed.

Each SFP cage on the Gigabit Ethernet MPA has an adjacent A/L LED visible on the front panel. The A/L LED indicates the status of the associated SFP port.

Figure 2-35 shows an example of the 20-port Gigabit Ethernet MPA.

Figure 2-35 20-Port Gigabit Ethernet MPA



8-port 10-Gigabit Ethernet Modular Port Adapter

The 8-Port 10-Gigabit Ethernet modular port adapter provides eight cages for SFP+ Ethernet optical interface modules that operate at a rate of 10-Gbps.

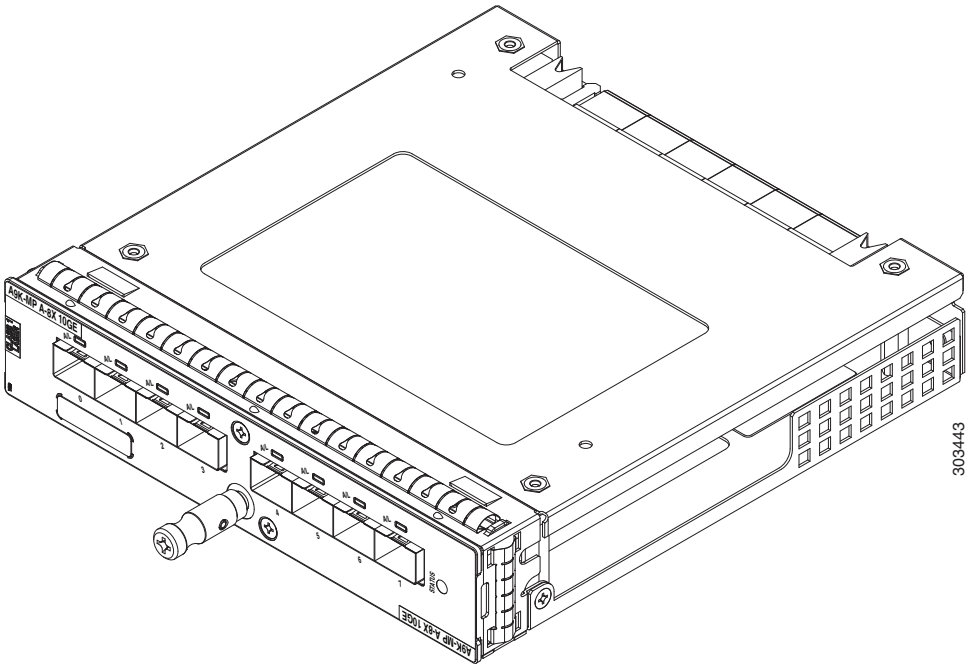
The 8-Port 10-Gigabit Ethernet modular port adapter has the following guidelines and limitations:

- The 8-Port 10-Gigabit Ethernet modular port adapter is supported on the 160-Gigabyte Modular Line Card only (A9K-MOD160-TR and A9K-MOD160-SE).
- The 8-Port 10-Gigabit Ethernet modular port adapter is *not supported* on the 80-Gigabyte Modular Line Card (A9K-MOD80-TR and A9K-MOD80-SE).
- The 8-Port 10-Gigabit Ethernet modular port adapter is *not supported* on the Cisco ASR 9001 Router.

Each SFP+ cage on the 8-Port 10-Gigabit Ethernet modular port adapter has an adjacent A/L (Active/Link) LED visible on the front panel. The A/L (Active/Link) LED indicates the status of the associated SFP+ port.

Figure 2-36 shows an example of the 8-Port 10-Gigabit Ethernet MPA.

Figure 2-36 8-Port 10-Gigabit Ethernet MPA



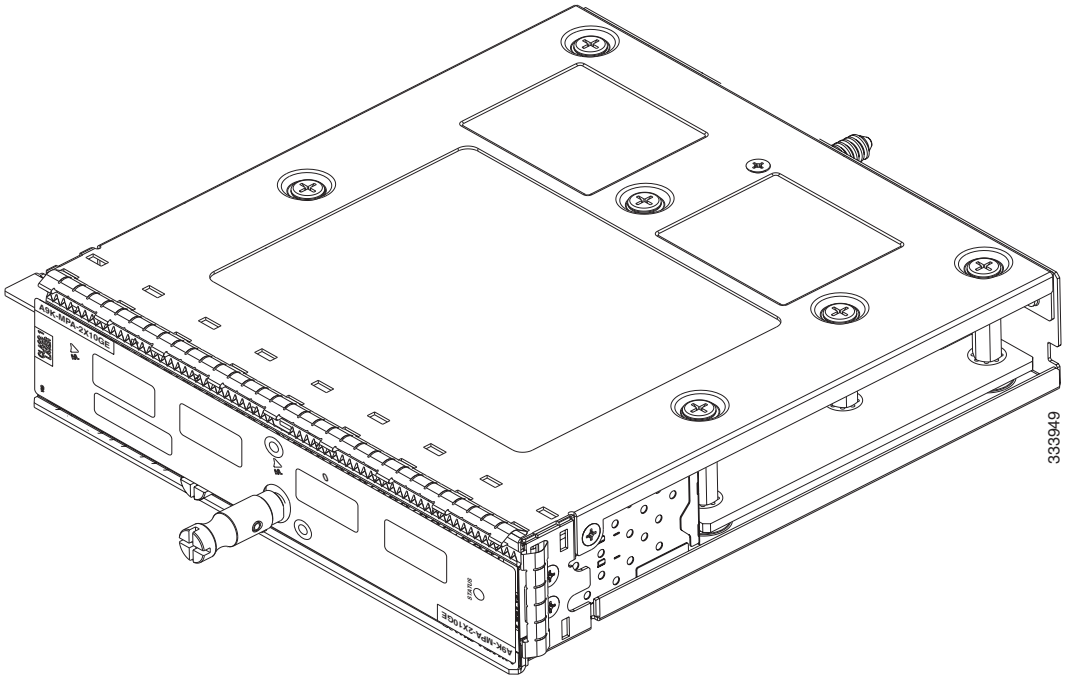
4-Port 10-Gigabit Ethernet Modular Port Adapter

The 4-Port 10-Gigabit Ethernet MPA provides four cages for XFP Ethernet optical interface modules that operate at a rate of 10-Gbps. The four XFP modules can be 10-Gigabit Ethernet multimode connections.

Each XFP cage on the 4-Port 10-Gigabit Ethernet MPA has an adjacent A/L LED visible on the front panel. The A/L LED indicates the status of the associated XFP port.

Figure 2-37 shows an example of the 4-Port 10-Gigabit Ethernet MPA.

Figure 2-37 4-Port 10-Gigabit Ethernet MPA



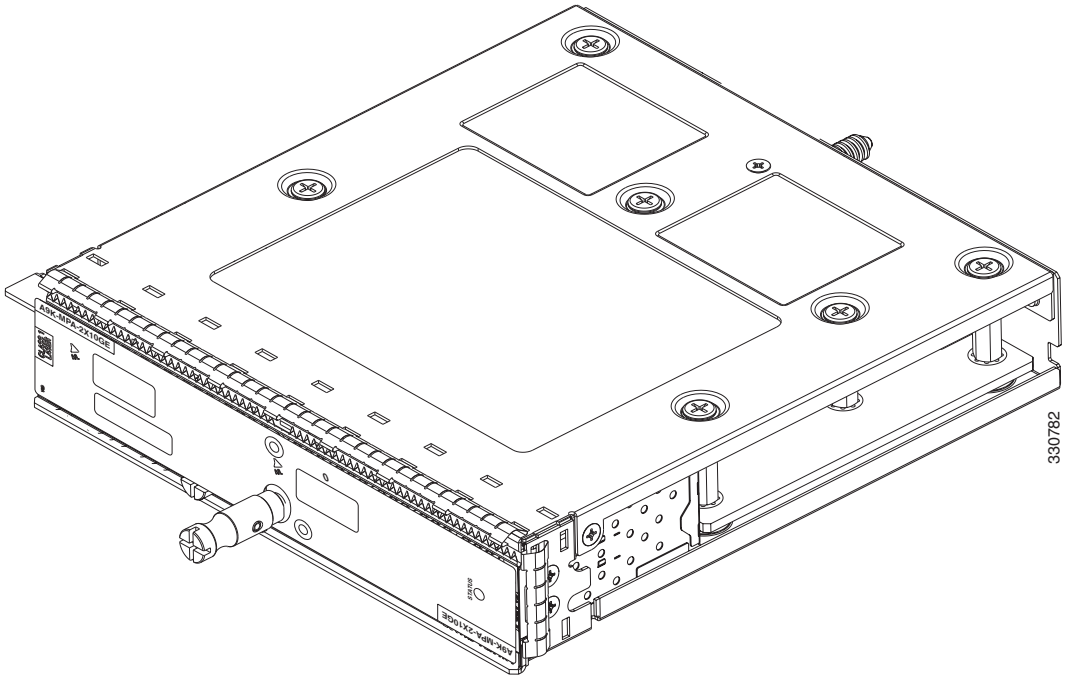
2-port 10-Gigabit Ethernet Modular Port Adapter

The 2-Port10-Gigabit Ethernet MPA provides two cages for XFP Ethernet optical interface modules that operate at a rate of 10-Gbps. The two XFP modules can be 10-Gigabit Ethernet multimode connections.

Each XFP cage on the 2-Port10-Gigabit Ethernet MPA has an adjacent A/L LED visible on the front panel. The A/L LED indicates the status of the associated XFP port.

Figure 2-38 shows an example of the 2-port10-Gigabit Ethernet MPA.

Figure 2-38 2-Port 10-Gigabit Ethernet MPA



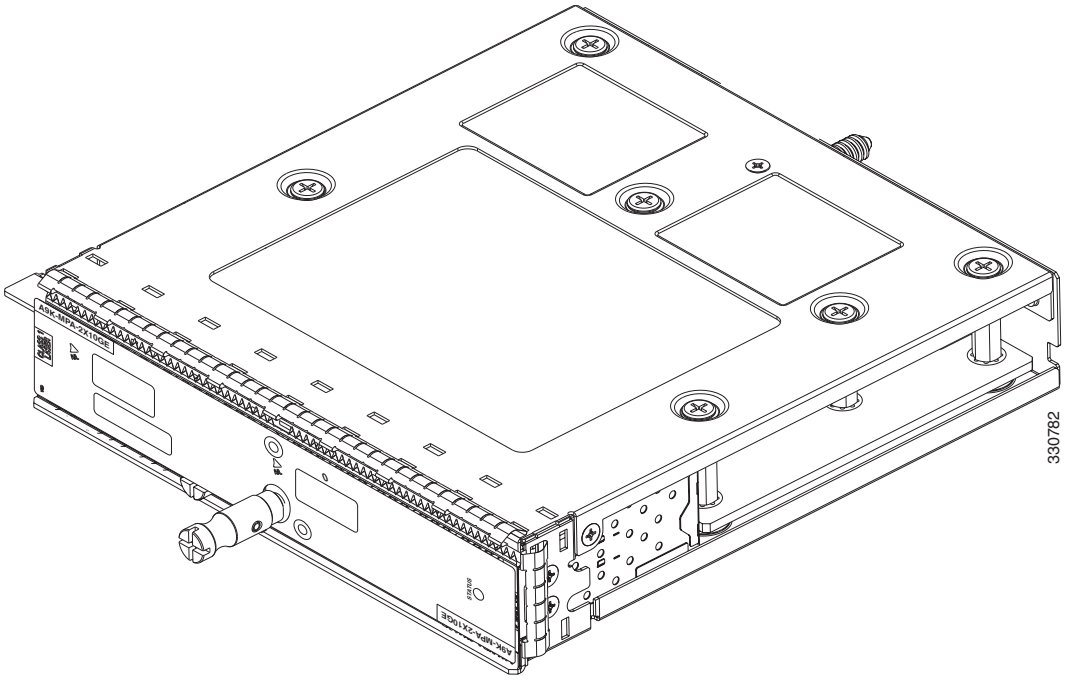
2-Port 40-Gigabit Ethernet Modular Port Adapter

The 2-Port 40-Gigabit Ethernet MPA provides two cages for QSFP+ Ethernet optical interface modules that operate at a rate of 40 Gbps. The two QSFP+ modules can be 40-Gigabit Ethernet multimode or single mode connections.

Each QSFP+ cage on the 2-Port 40-Gigabit Ethernet MPA has an adjacent A/L LED visible on the front panel. The A/L LED indicates the status of the associated QSFP+ port.

Figure 2-39 shows an example of the 2-Port 40-Gigabit Ethernet MPA.

Figure 2-39 2-Port 40-Gigabit Ethernet MPA



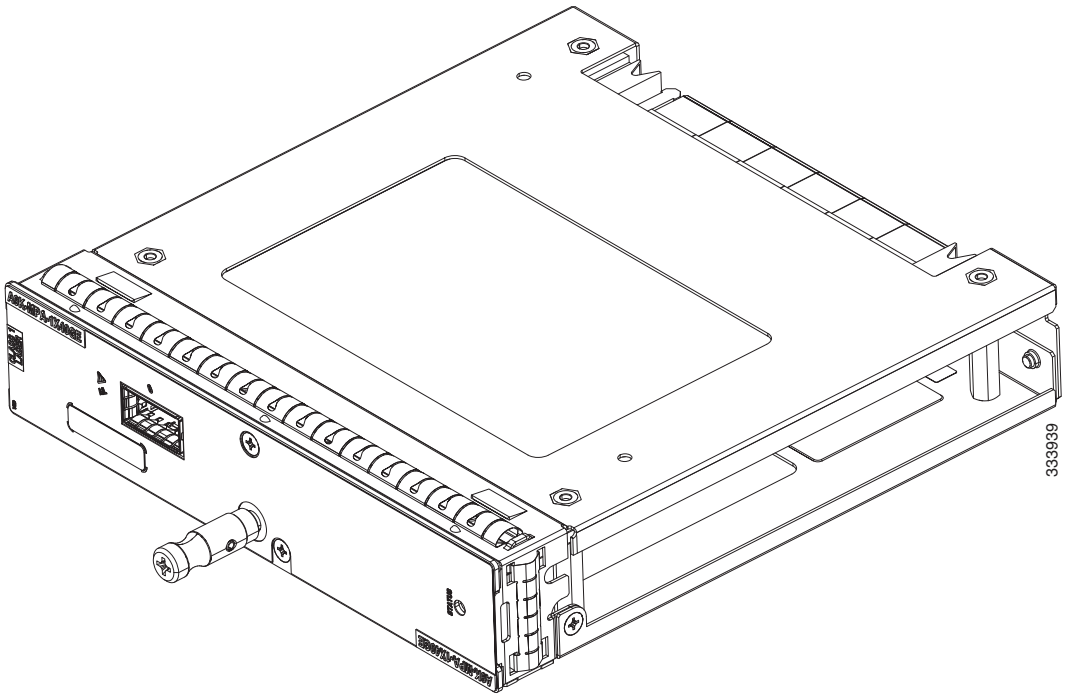
1-Port 40-Gigabit Ethernet Modular Port Adapter

The 1-Port 40-Gigabit Ethernet modular port adapter provides a cage for a QSFP+ Ethernet optical interface module that operates at a rate of 40-Gbps. The QSFP+ module can support either a 40-Gigabit Ethernet multimode connection or a 40-Gigabit Ethernet single mode connection.

Each QSFP cage on the 1-Port 40 Gigabit Ethernet modular port adapter has an adjacent A/L (Active/Link) LED visible on the front panel. The A/L LED indicates the status of the associated QSFP+ port.

Refer to Figure 2-40 below for an example of the 1-Port 40-Gigabit Ethernet modular port adapter.

Figure 2-40 1-Port 40-Gigabit Ethernet Modular Port Adapter



Power System Functional Description

The Cisco ASR 9000 Series Routers 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—AC/DC bulk power supply tray connected to the user's 200 to 240 V +/- 10 percent (180 to 264 VAC) source.
- DC systems—DC/DC bulk power supply tray connected to the user's Central Office DC battery source (–54 VDC nominal).

The system backplane distributes DC power from the backplane 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. In the Cisco ASR 9922 Router and Cisco ASR 9912 Router, the internal –54 VDC power distribution is isolated from the central office by the transformers inside the power modules. It has single-point grounding on the –54 VDC Return internal distribution bus.

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 2-41 and Figure 2-42 show block diagrams of the ASR 9010 Router AC power system with version 1 and version 2 power systems. Figure 2-43 and Figure 2-44 show block diagrams of the ASR 9010 Router DC power system with version 1 and version 2 power systems.

Note The Cisco ASR 9000 Series Routers have two available DC version 1 power modules, a 2100 W module and a 1500 W module. Both types of power modules can be used in a single chassis. The ASR 9000 Series Routers have one available DC version 2 power module (2100 W).

Figure 2-41 Cisco ASR 9010 Router AC Power System Block Diagram—Version 1 Power System

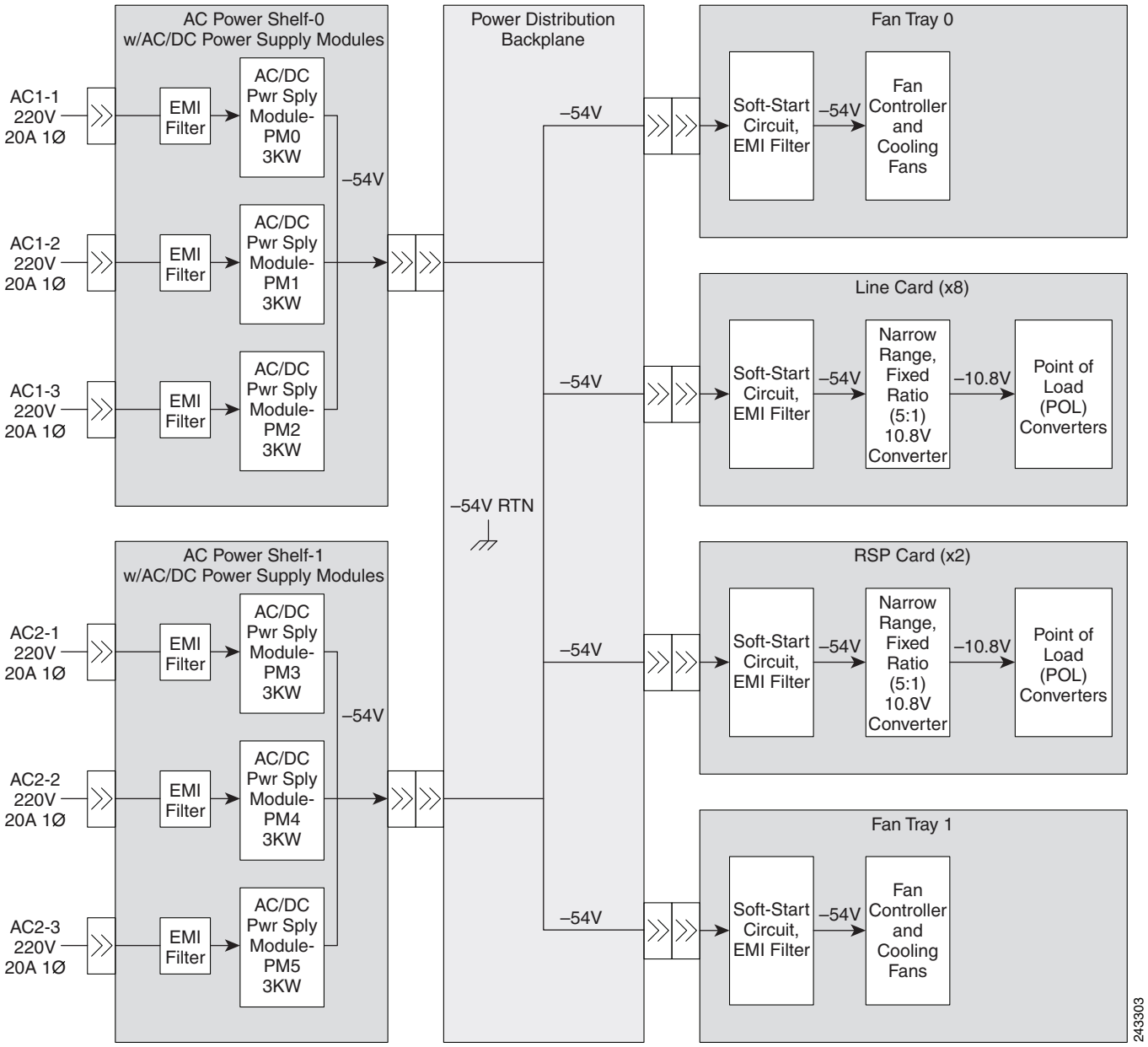


Figure 2-42 Cisco ASR 9010 Router AC Power System Block Diagram—Version 2 Power System

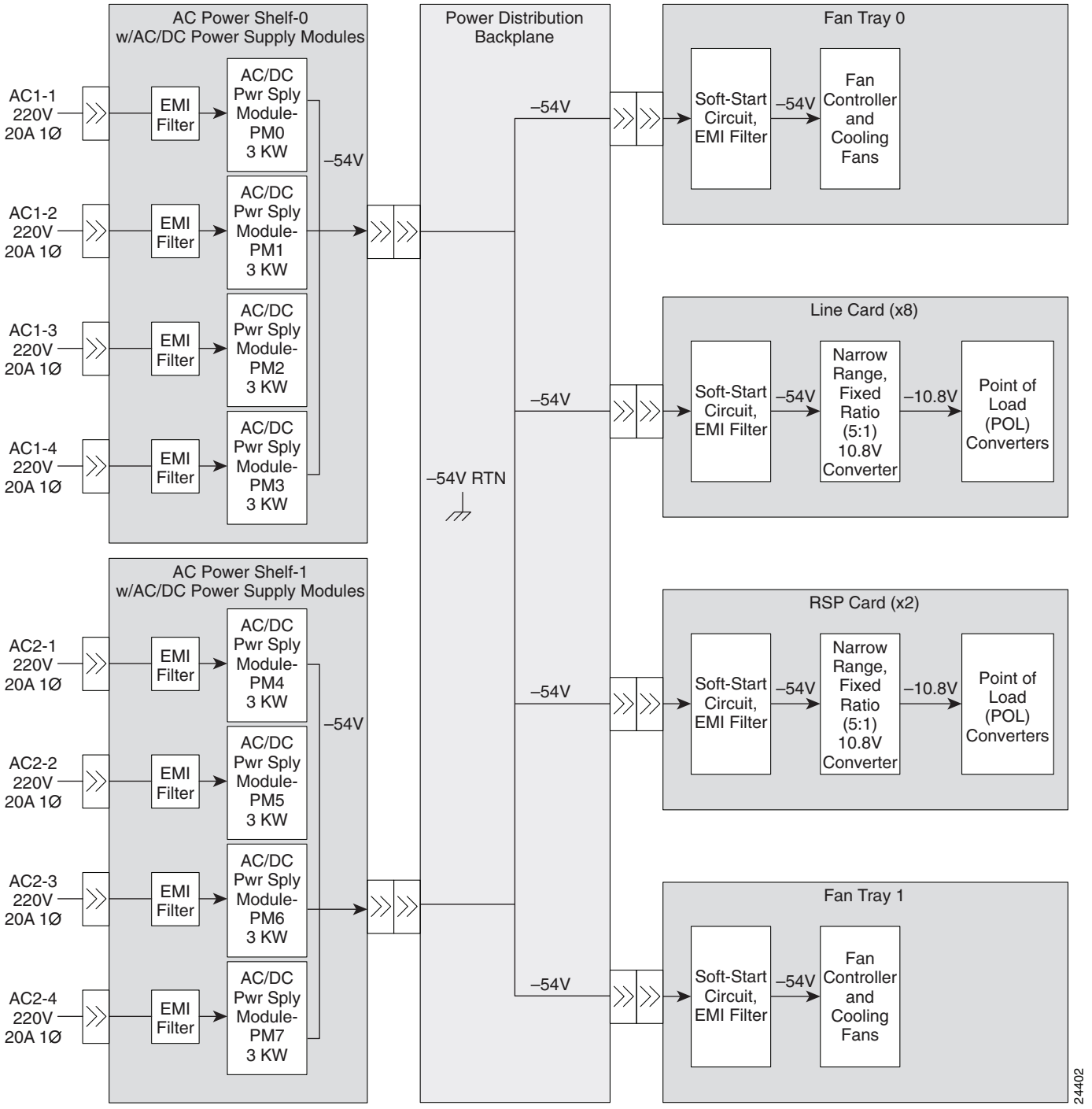


Figure 2-43 Cisco ASR 9010 Router DC Power System Block Diagram—Version 1 Power System

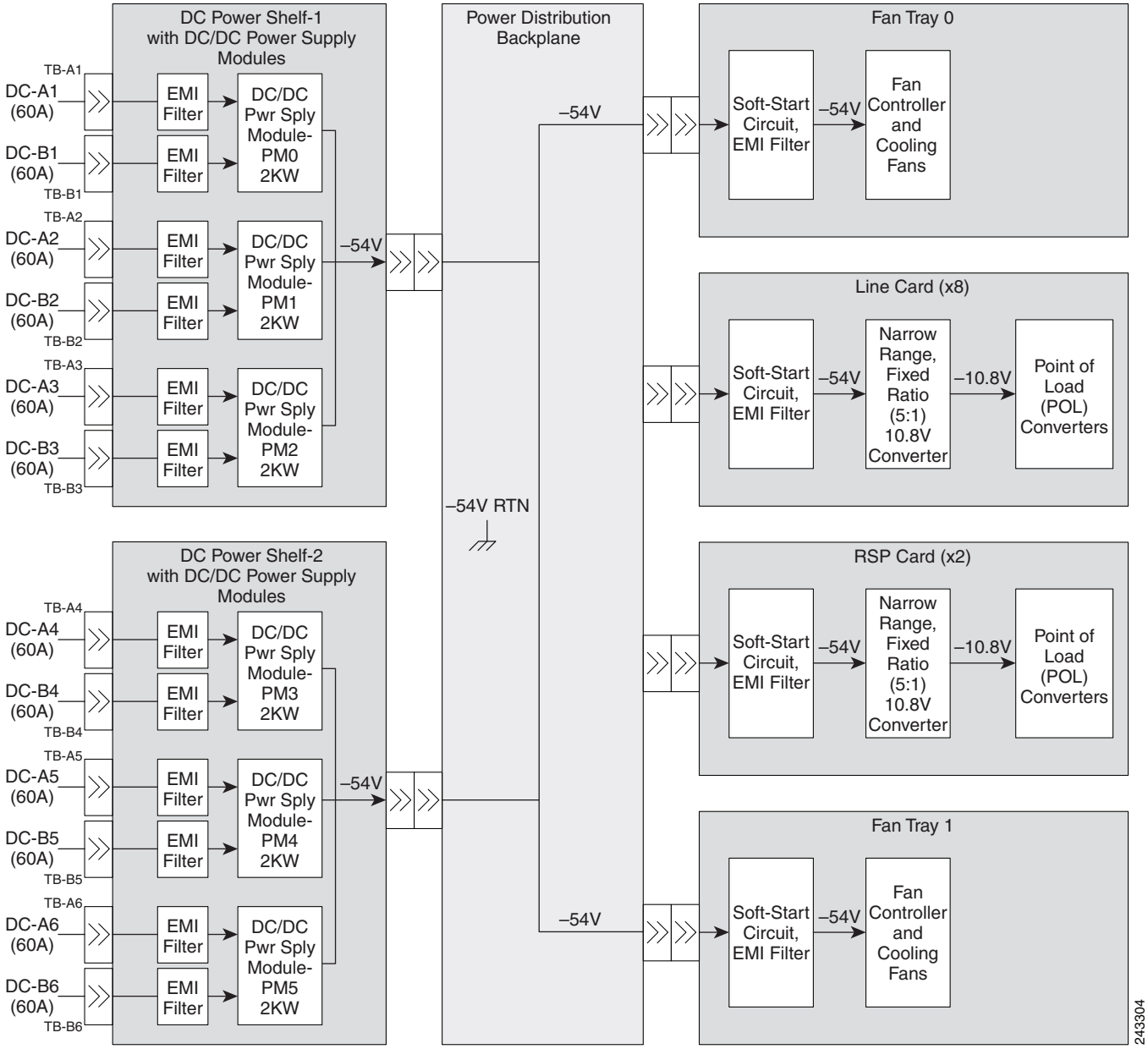


Figure 2-44 Cisco ASR 9010 Router DC Power System Block Diagram—Version 2 Power System

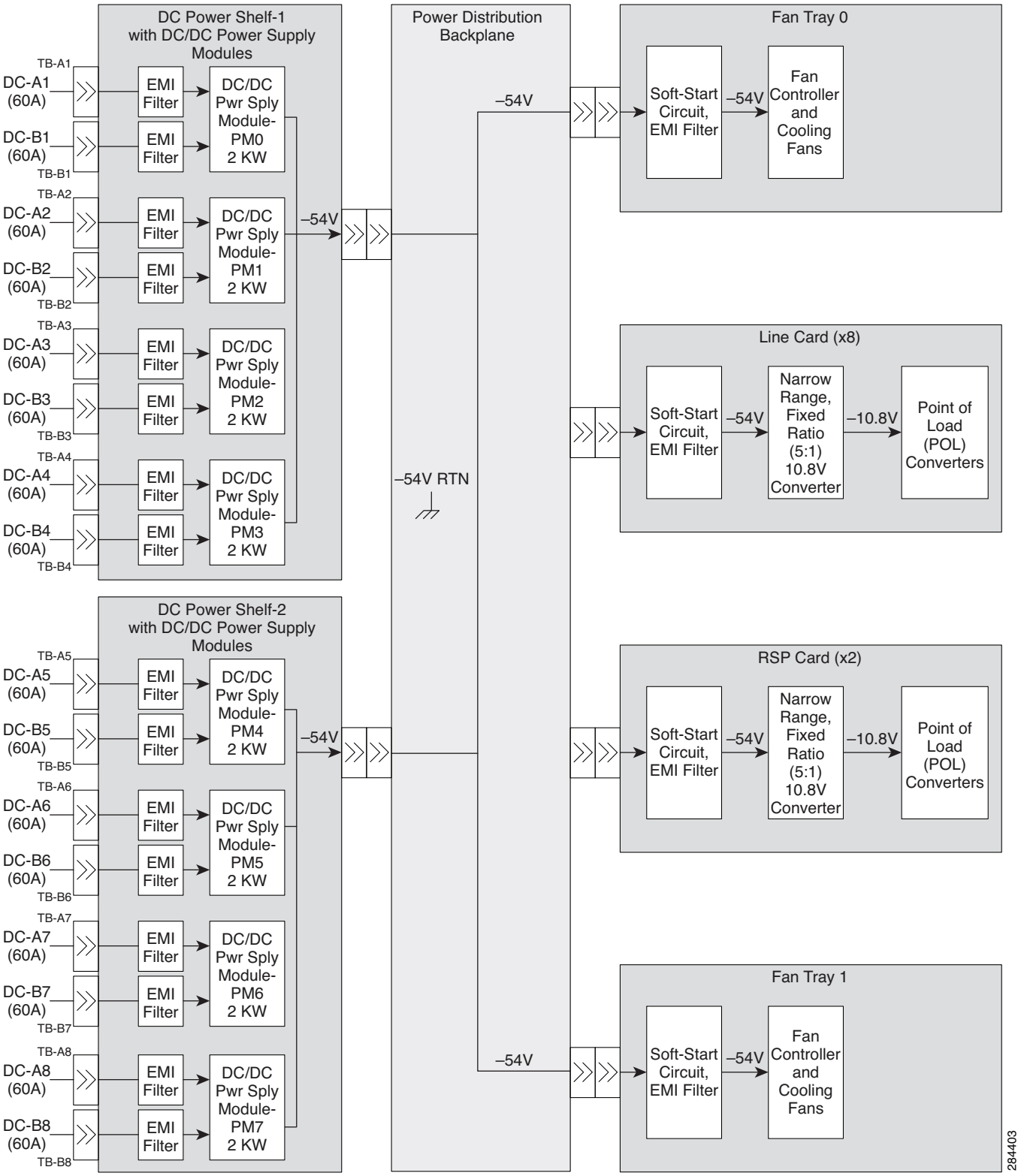


Figure 2-45 and Figure 2-46 show block diagrams of the Cisco ASR 9006 Router AC power system with version 1 and version 2 power systems. Figure 2-47 and Figure 2-48 show block diagrams of the Cisco ASR 9006 Router DC power system with version 1 and version 2 power systems.

Figure 2-45 Cisco ASR 9006 Router AC Power System Block Diagram—Version 1 Power System

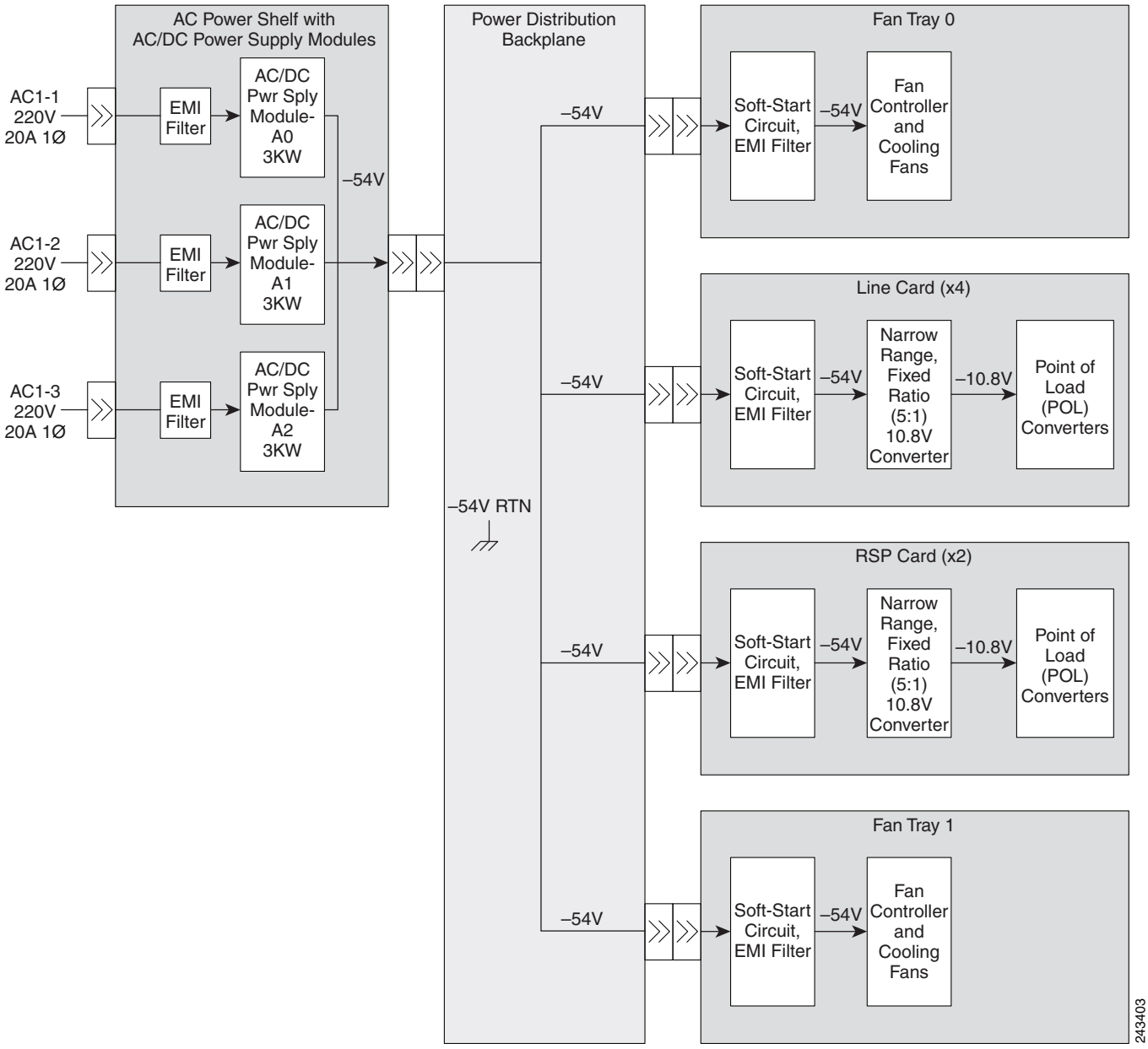


Figure 2-46 Cisco ASR 9006 Router AC Power System Block Diagram—Version 2 Power System

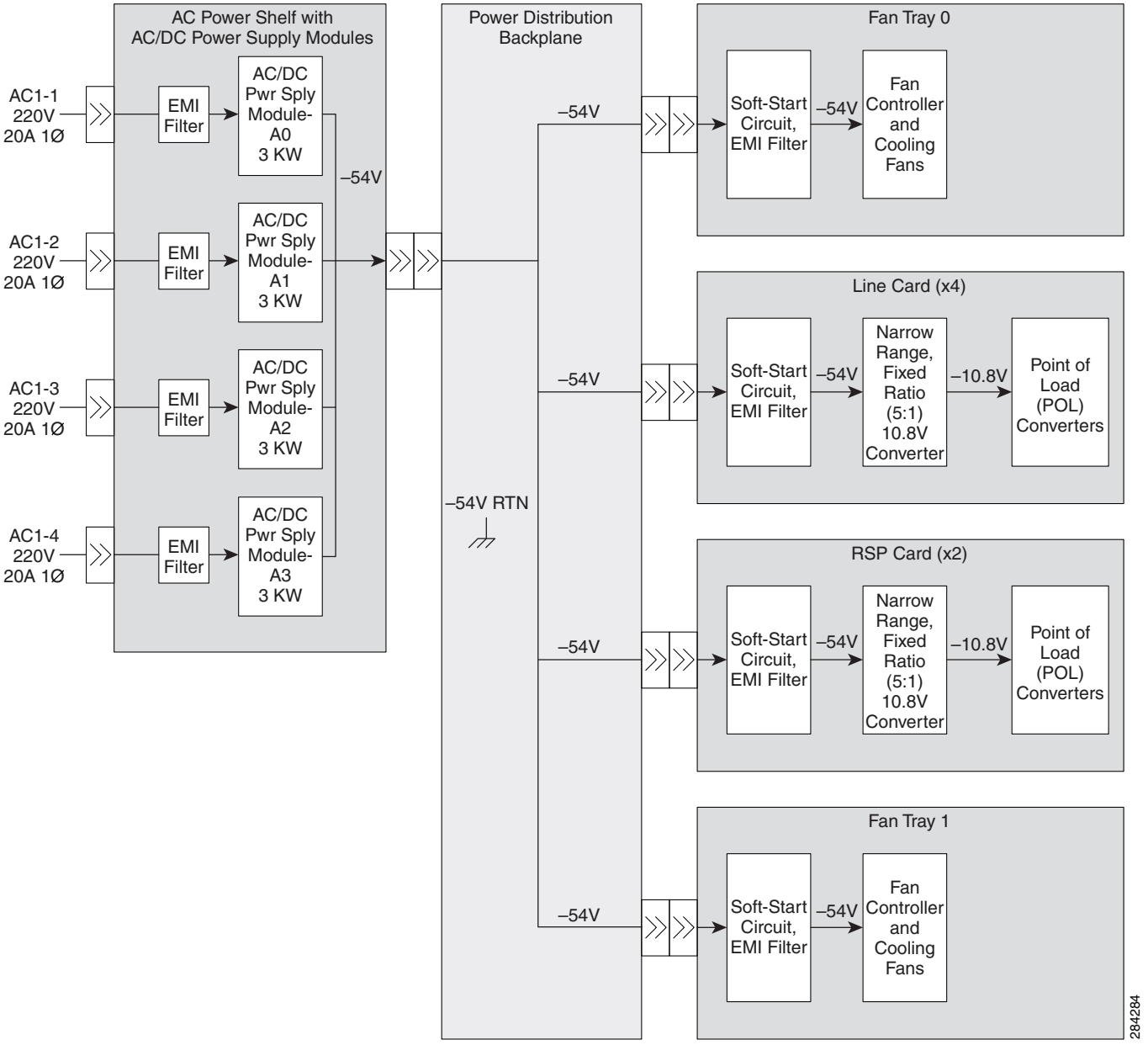


Figure 2-47 Cisco ASR 9006 Router DC Power System Block Diagram—Version 1 Power System

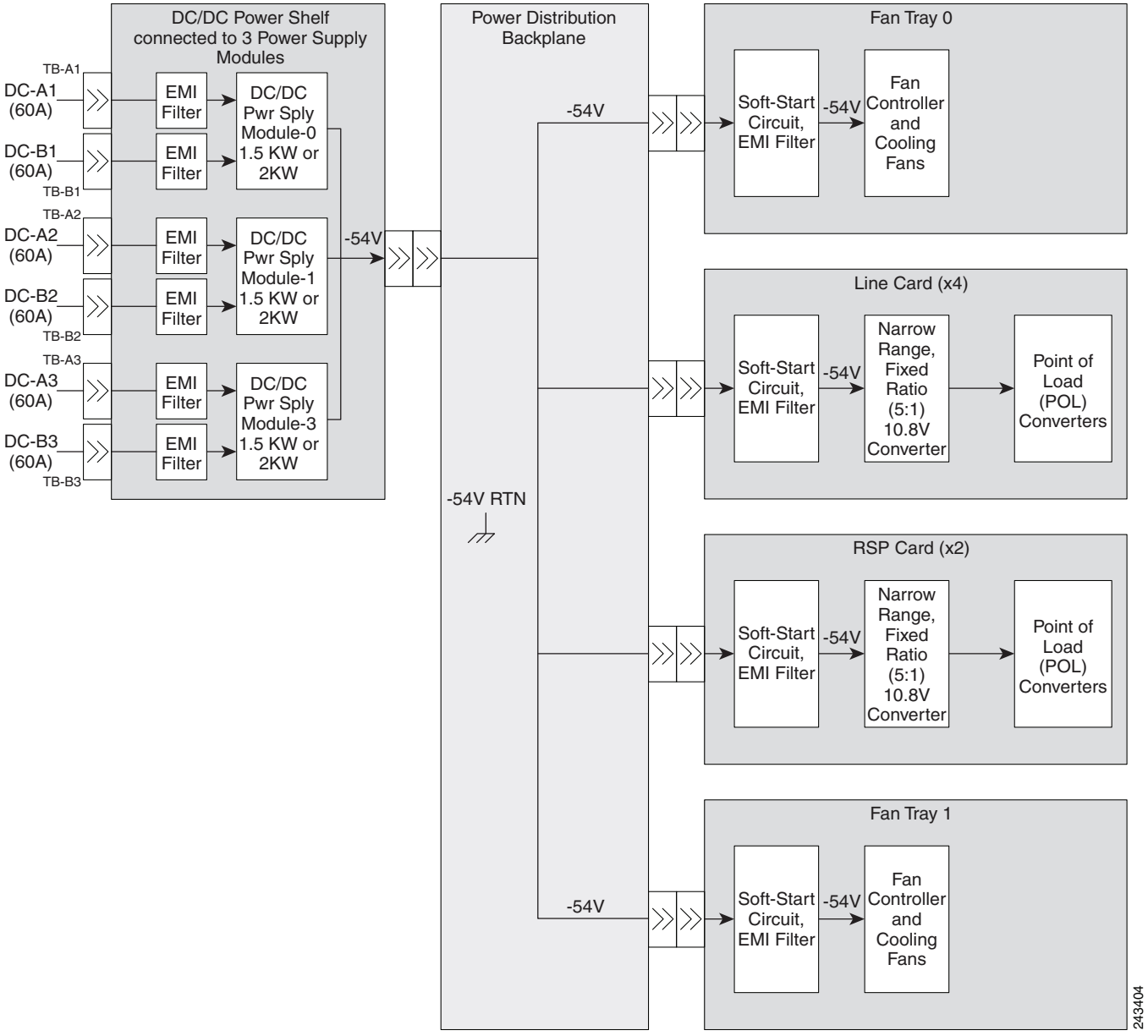


Figure 2-48 Cisco ASR 9006 Router DC Power System Block Diagram—Version 2 Power System

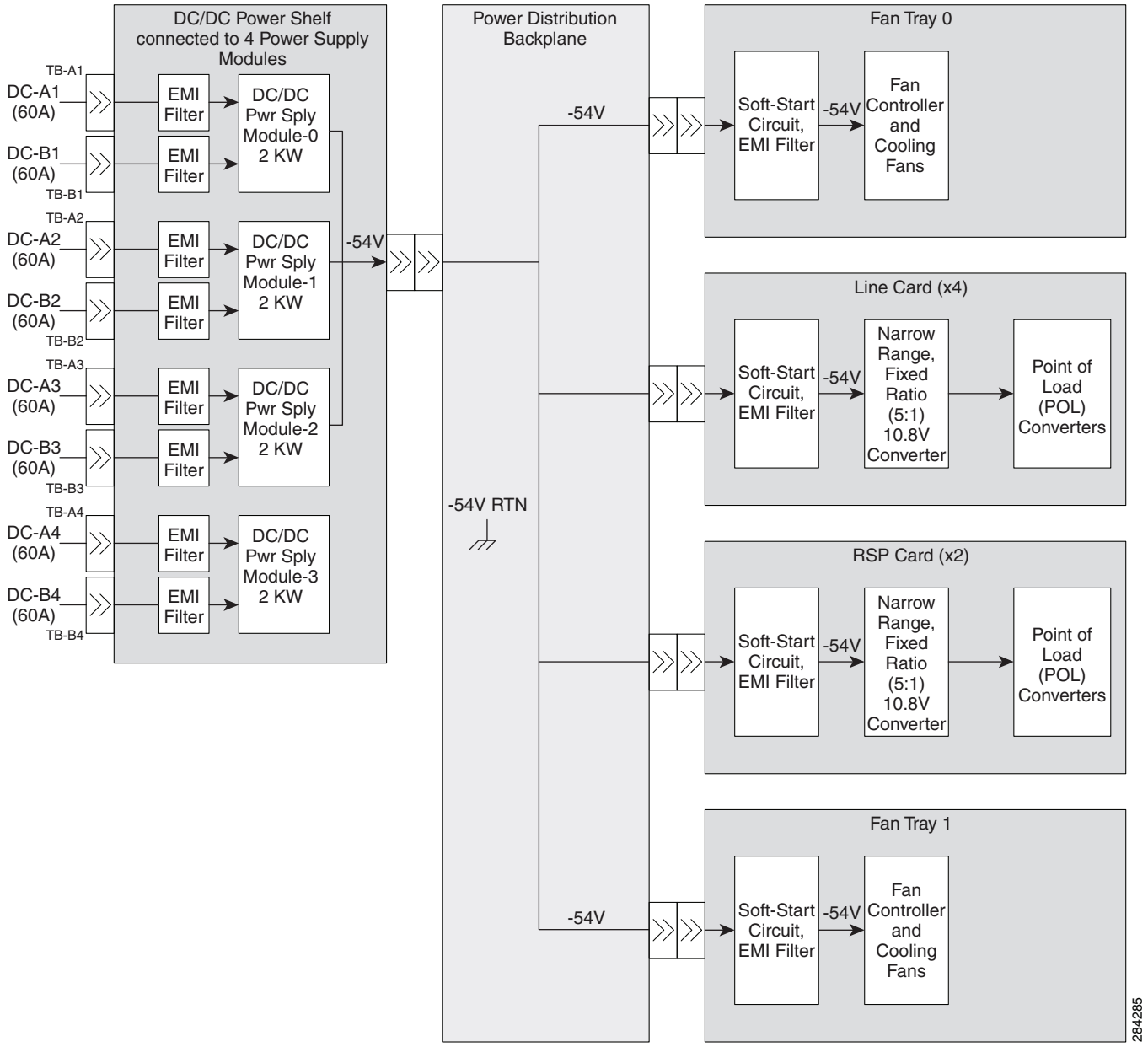


Figure 2-49 and Figure 2-50 shows block diagrams of the Cisco ASR 9904 Router with the AC and DC version 2 power system.

Figure 2-49 Cisco ASR 9904 Router AC Power System Block Diagram—Version 2 Power System

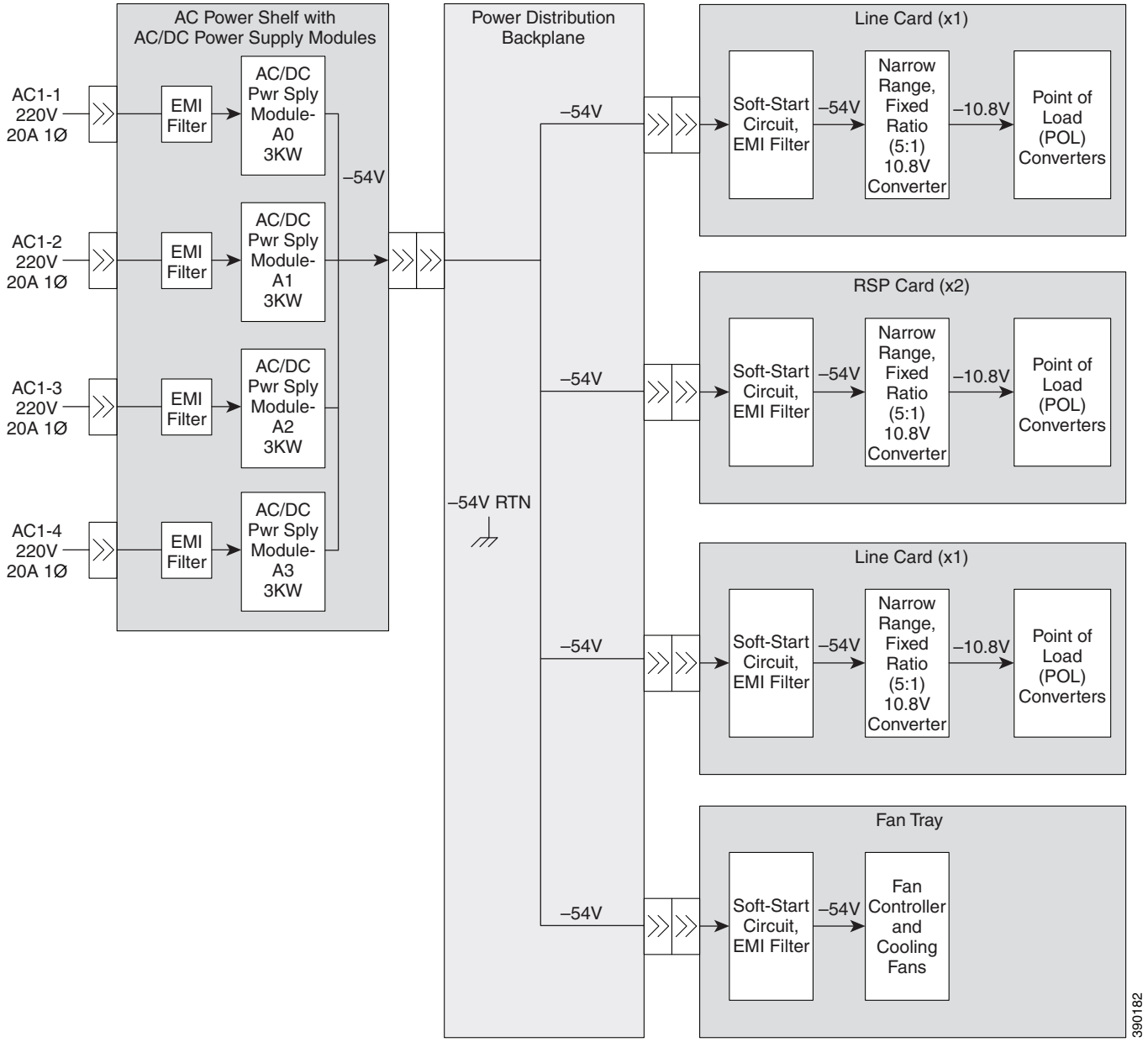


Figure 2-50 Cisco ASR 9904 Router DC Power System Block Diagram—Version 2 Power System

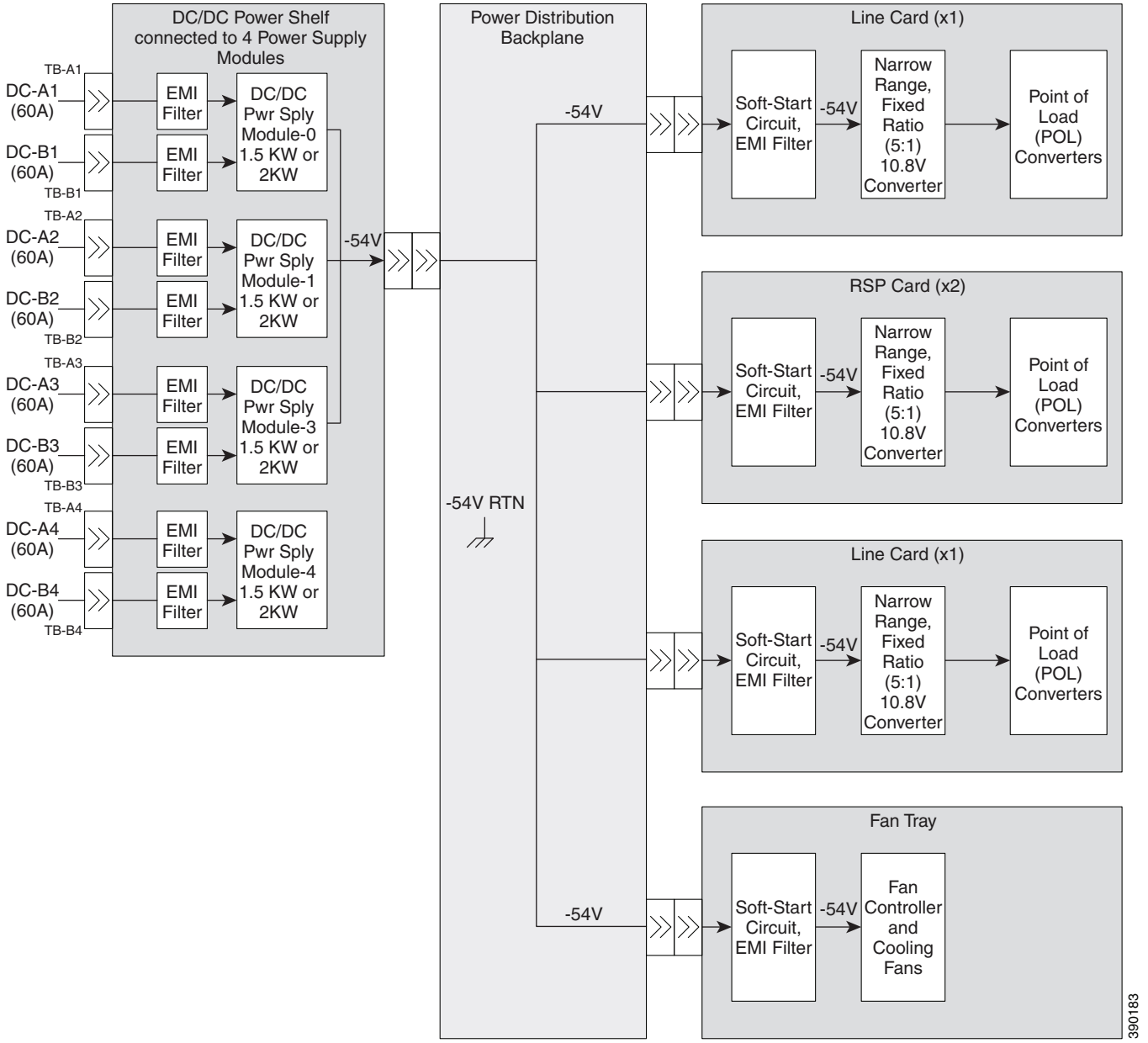


Figure 2-51 and Figure 2-52 show block diagrams of the Cisco ASR 9922 Router with AC and DC version 2 power systems.

Figure 2-51 Cisco ASR 9922 Router AC Power System Block Diagram—Version 2 Power System

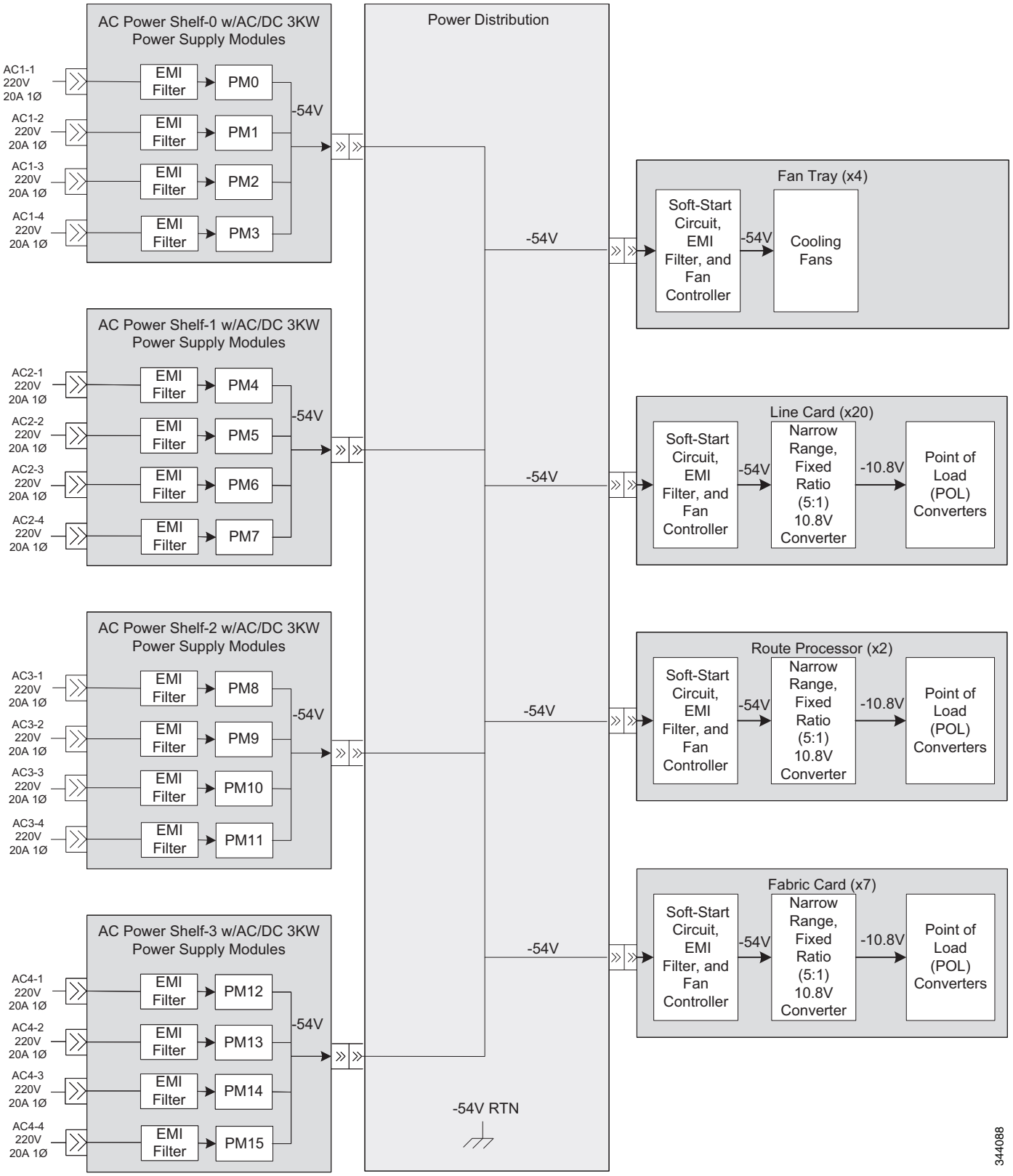
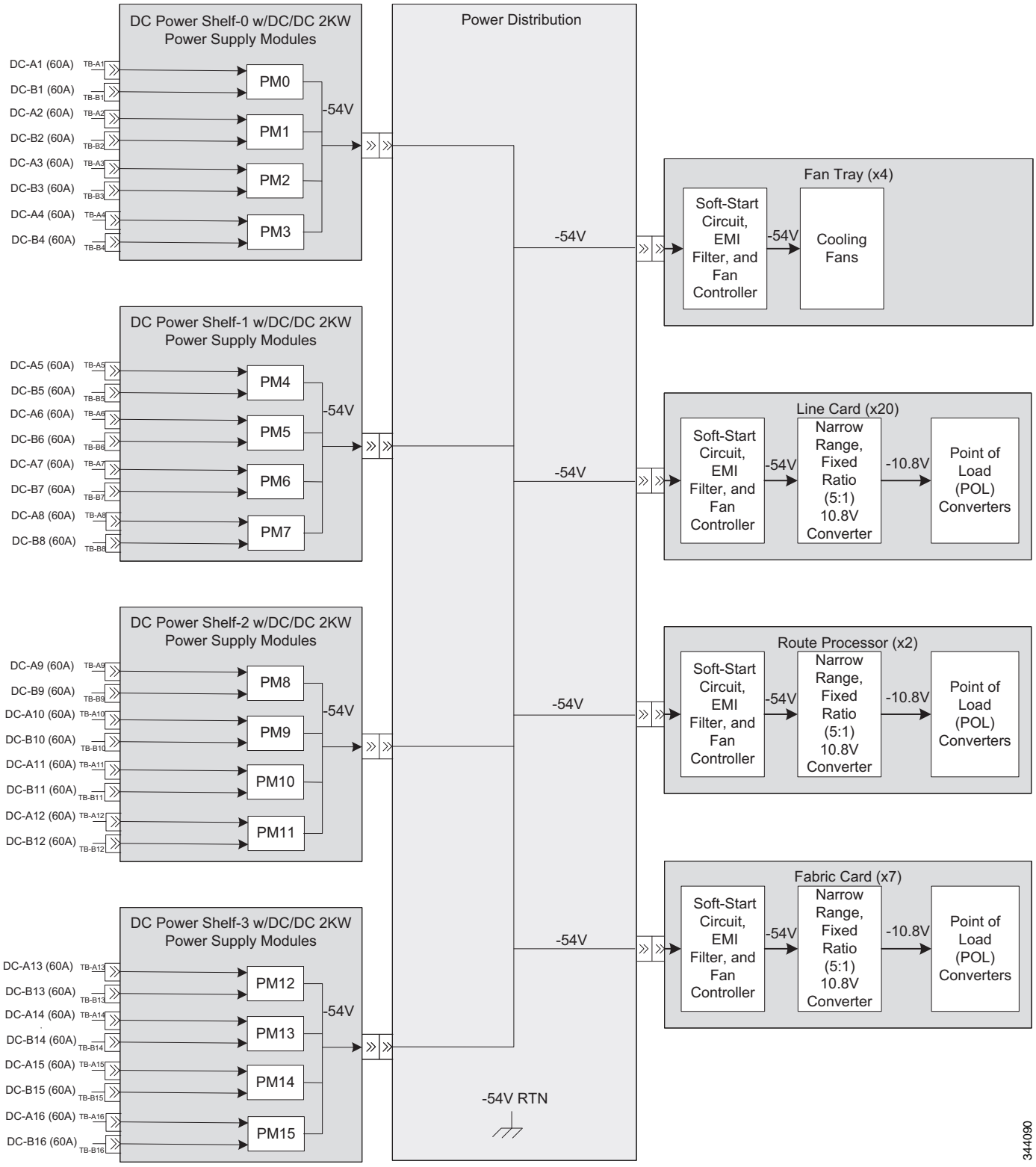


Figure 2-52 Cisco ASR 9922 Router DC Power System Block Diagram—Version 2 Power System

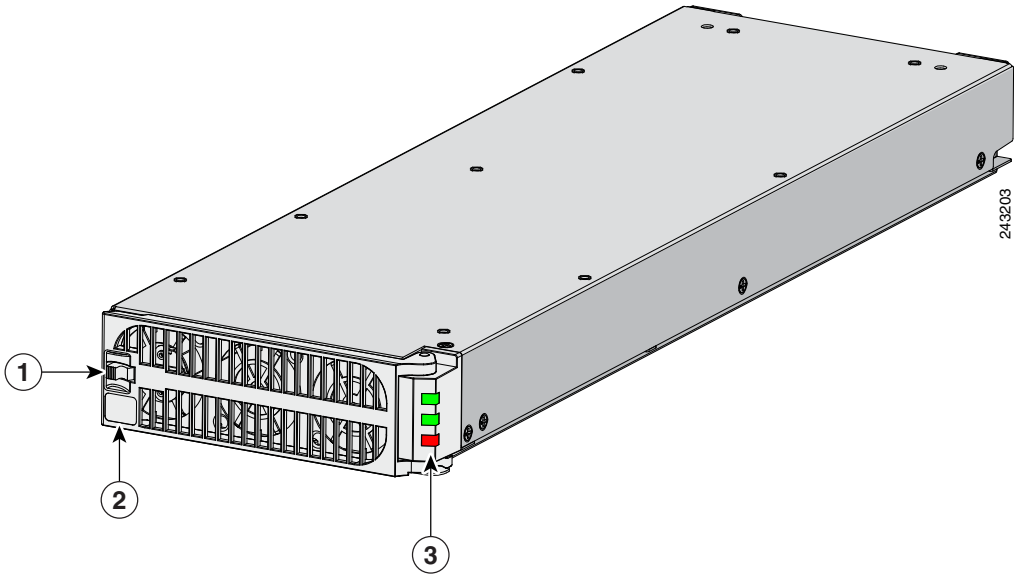


Power Modules

Multiple AC/DC power modules can be installed in each AC/DC power tray.

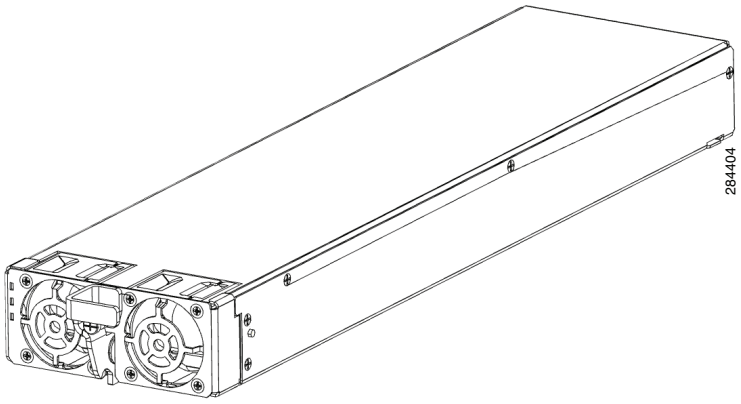
Figure 2-53 shows the version 1 power module, and Figure 2-54 shows the version 2 power module.

Figure 2-53 Version 1 Power Module



1	Door latch	**2**	Door and ejector lever	**3**	LED indicators

Figure 2-54 Version 2 Power Module



Power Module Status Indicators

Figure 2-55 shows the status indicators for the version 1 power module and Figure 2-56 shows the status indicators for the version 2 power module. The indicator definitions follow the two figures.

Figure 2-55 Version 1 Power Module Status Indicators

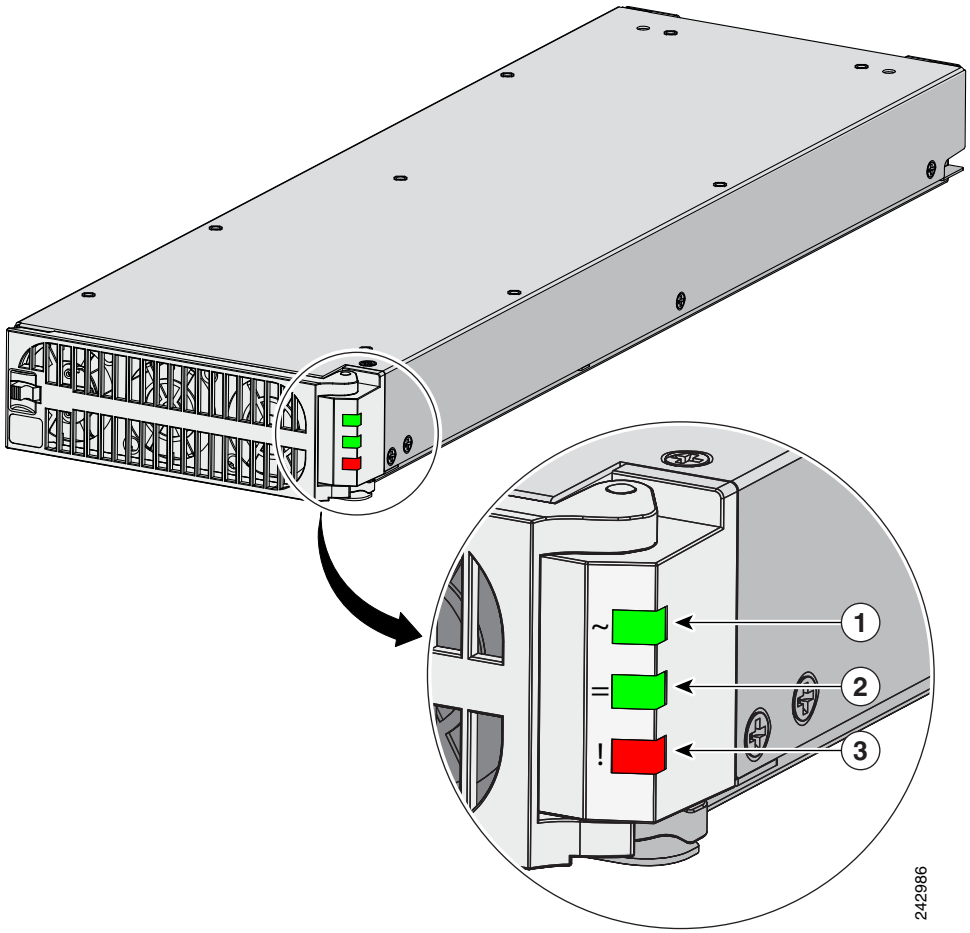
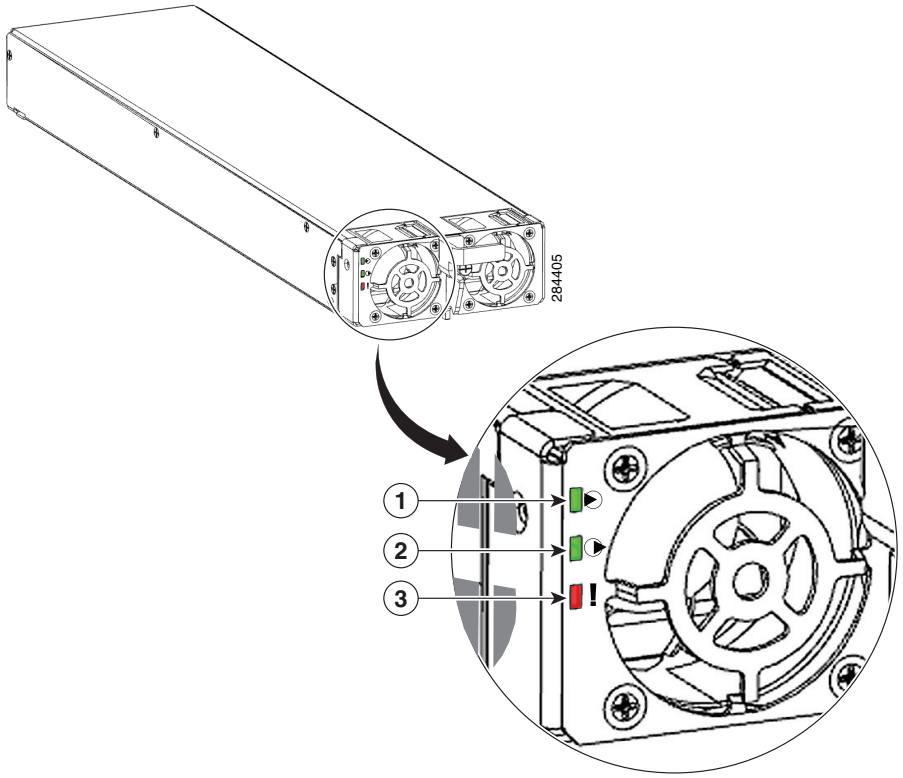


Figure 2-56 Version 2 Power Module Status Indicators



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.

System Power Redundancy

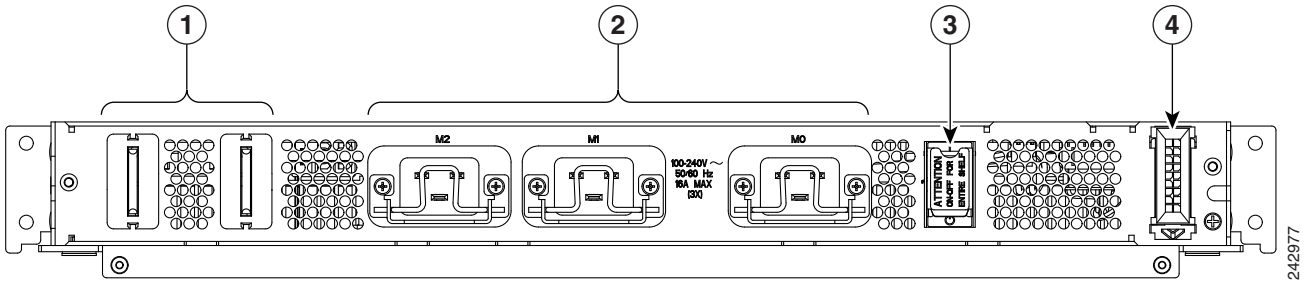
Both the AC and DC power systems have system power redundancy depending on the chassis configuration. Each tray can house up to four modules and can be configured for multiple power configurations. For more information about power system redundancy, see the "Power Supply Redundancy" section on page 3-3.

AC Power Trays

The AC power tray provides 20-A UL/CSA-rated, 16-IEC-rated AC receptacles. The version 1 receptacle has a bail lock retention bracket to retain the power cord. The version 2 receptacle has a clamp mechanism with a screw that can be tightened to retain the power cord. DC output power from the AC power tray 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.

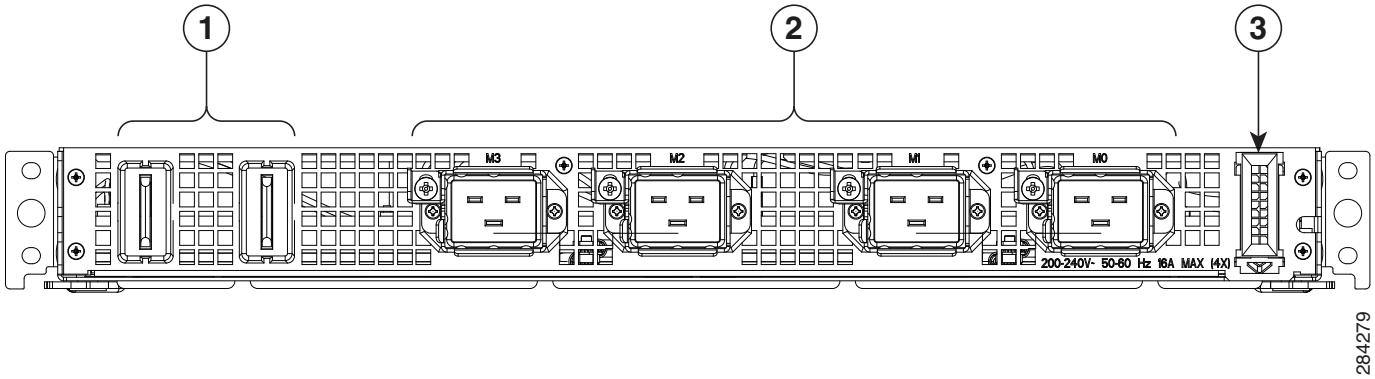
Figure 2-57 shows the back of the version 1 AC power tray and Figure 2-58 shows the back of the version 2 power tray.

Figure 2-57 Version 1 AC Power Tray Rear Panel



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

Figure 2-58 Version 2 AC Power tray Rear Panel



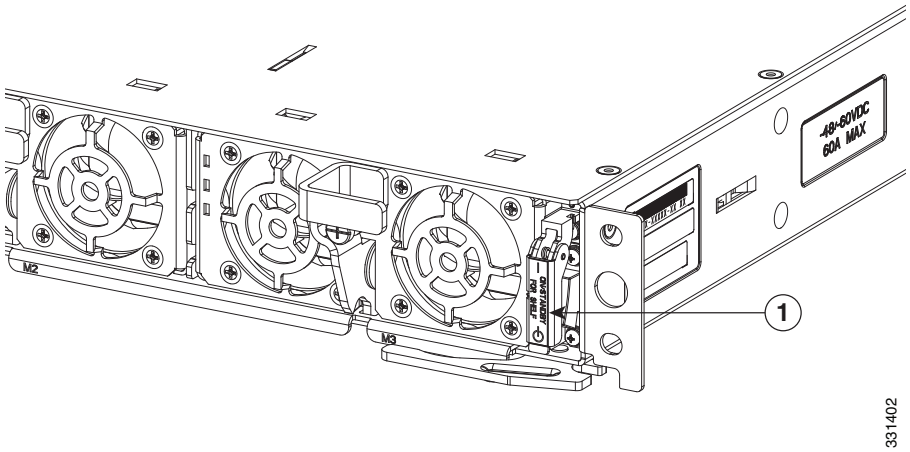
1	DC output power blades	**3**	I2C cable from backplane
2	IEC input receptacles with retention brackets		

AC Tray Power Switch

Each AC power tray provides a single-pole, single-throw power switch to power on and put in standby mode all power modules installed in the tray simultaneously. When the power modules are turned off, only the DC output power is turned off; the power module fans and LEDs still function. The power switch

for the version 1 power tray is on the back of the tray, as shown in Figure 2-57. The power switch for the version 2 power tray is on the front of the tray, as shown in Figure 2-59.

Figure 2-59 Location of AC Power Switch - Version 2 Power System



1	Power switch

AC Input Voltage Range

Each AC module accepts an individual single phase 220-VAC 20-A source. Table A-17 shows the limits of the specified AC input voltage. The voltages given are single phase power source.

DC Output Levels

The output for each module is within the tolerance specifications (see Table A-19) 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 tray 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 three 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 tray by toggling the user'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 trays to the ON position.
3. AC/DC modules in the power trays provide –54 VDC output within six seconds after the AC is applied.

4. The soft-start circuit in the logic cards takes 100 milliseconds 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 milliseconds 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 trays stay within regulation for a minimum of 15 milliseconds after the AC power is removed.
3. The –54 V to the logic card ramps down to –36 V in 15 milliseconds 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 0.1 millisecond.

DC Power Trays

The DC power tray (see Figure 2-60) provides two power feed connector banks: A feed and B feed. System communication is through a I2C cable from the backplane.

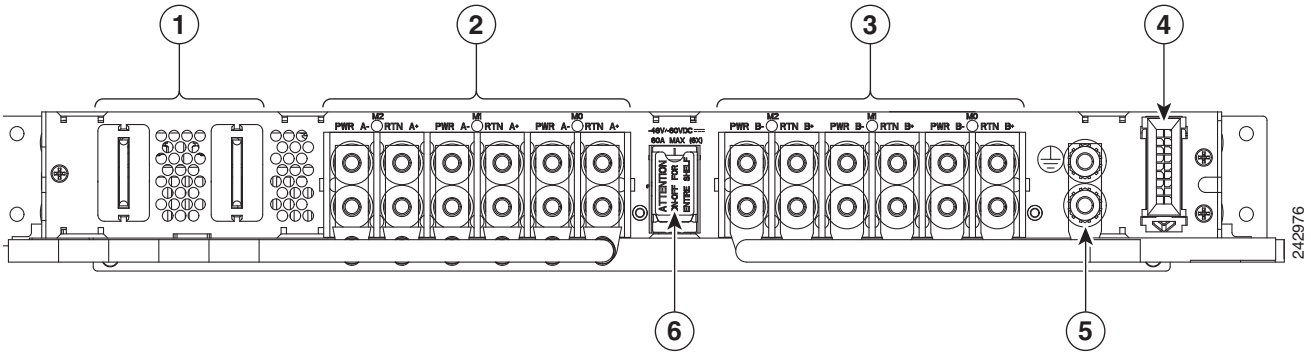
DC Tray Power Switch

Each DC power tray provides a single-pole, single-throw power switch to power on and off all of the power modules installed in the tray simultaneously. When the power modules are turned off, only the DC output power is turned off; the power module fans and LEDs still function. The power switch is on the front panel.

DC Power Tray Rear Panel

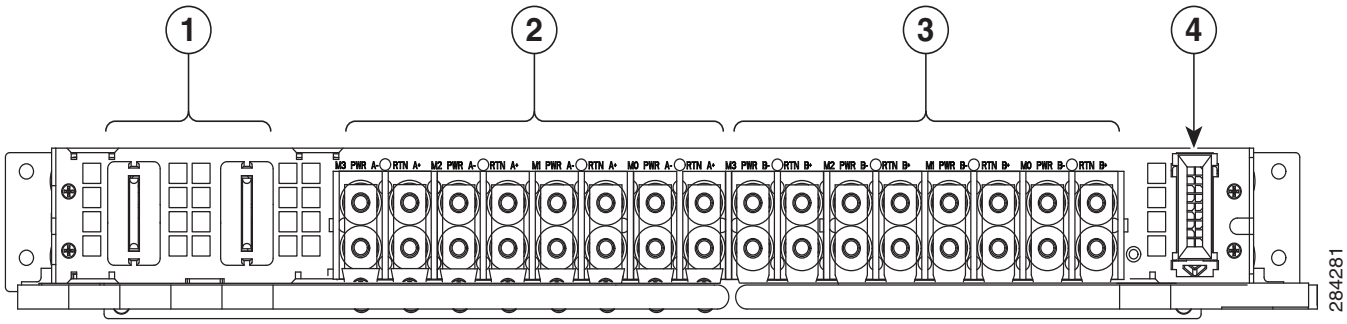
Figure 2-60 shows the rear panel of the power tray for the version 1 power system. Figure 2-61 shows the rear panel of the power tray for the version 2 power system.

Figure 2-60 DC Power Tray 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

Figure 2-61 DC Power Tray Rear Panel - Cisco ASR 9006 Router and Cisco ASR 9904 Router with Version 2 Power System

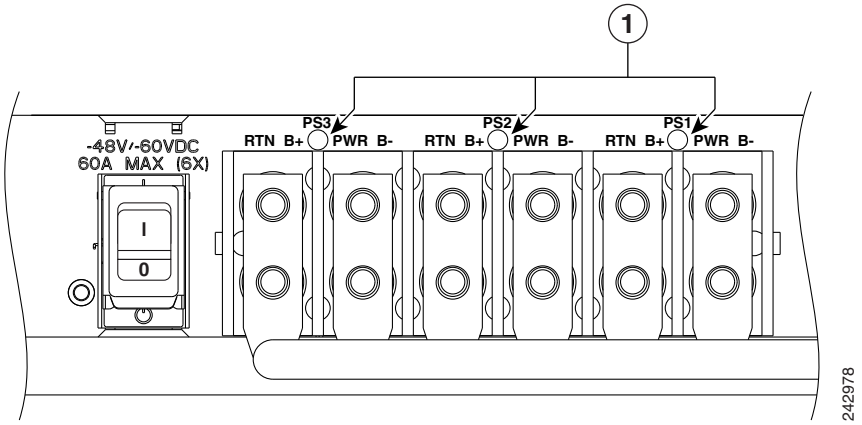


1	DC output power blades	**3**	“B” feed connectors
2	“A” feed connectors	**4**	I2C cable from backplane

DC Power Tray Power Feed Indicator

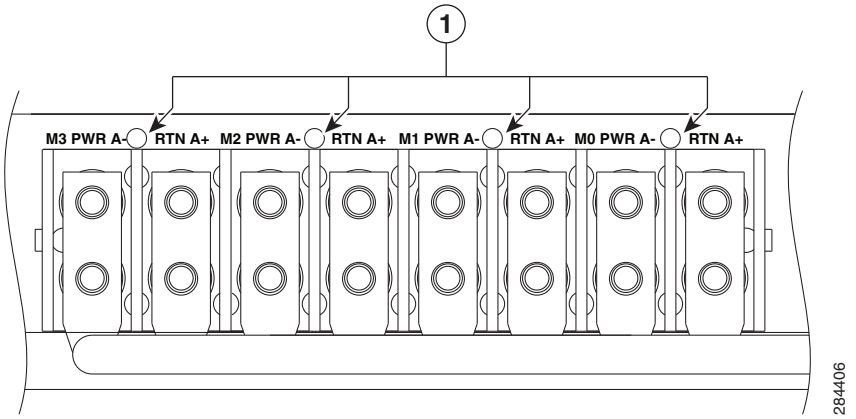
Figure 2-62 shows the location of the power feed indicators on the rear panel of the DC power tray for the Cisco ASR 9010 Router and Cisco ASR 9006 Router with a version 1 power system. Figure 2-63 shows the location of the power feed indicators on the rear panel of the DC power tray for the Cisco ASR 9006 Router and Cisco ASR 9904 Router with a version 2 power system.

Figure 2-62 DC Power tray Power Feed Indicator —Version 1 Power System



1	Power feed indicators

Figure 2-63 DC Power tray Power Feed Indicator —Version 2 Power System



1	Power feed indicators

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 tray by toggling the user'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 tray to ON position.
3. DC/DC power supply modules in the power tray provides –54 VDC output within seven seconds after the DC is applied.

4. The soft-start circuit in the logic cards takes 100 milliseconds 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 milliseconds 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 tray to OFF position.
2. The DC/DC modules in the power tray stays within regulation for a minimum of 3.5 milliseconds 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 milliseconds 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 0.1 millisecond.

Cooling System Functional Description

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

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

In the Cisco ASR 9006 Router, the two fan trays are located above the card cage, left of center, and side by side. They are covered by a fan tray door hinged at the bottom, which must be opened before removing the fan trays.

In the Cisco ASR 9904 Router, a single fan tray is located to the left of the card cage accessible from the rear, and is equipped with handles for easy removal.

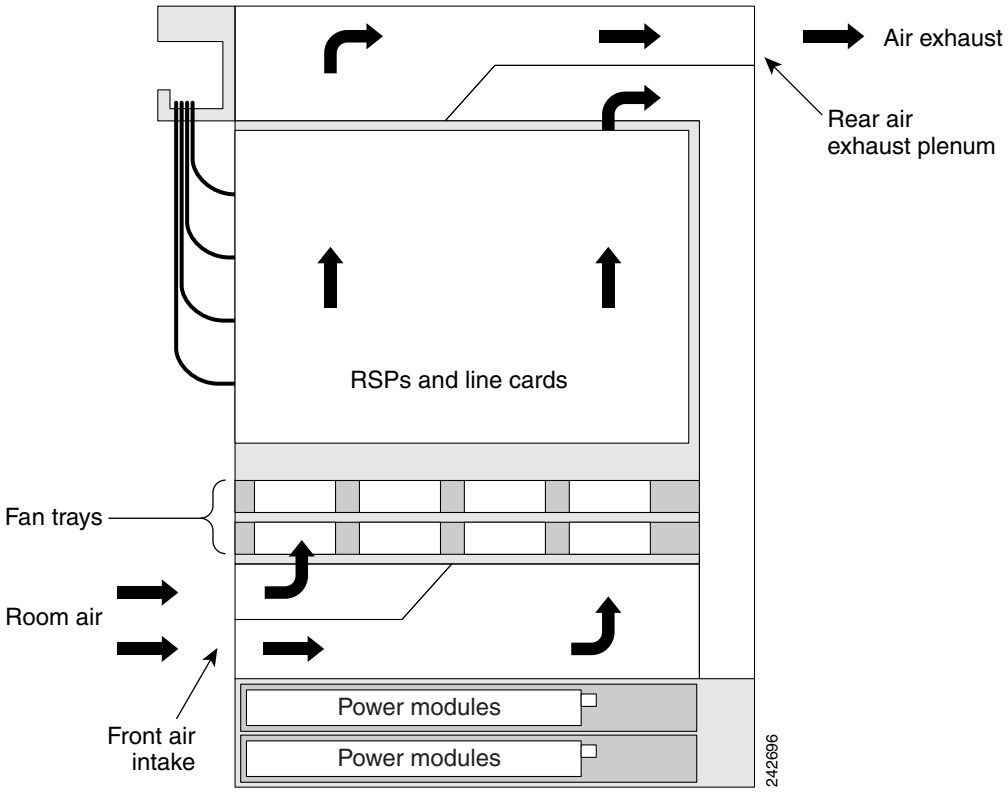
In the Cisco ASR 9922 Router, the two top fan trays are located between the top and middle cages, while the two bottom fan trays are located between the middle and bottom cages. The two bottom fan trays are inserted *upside down* compared to the two top fan trays. In the Cisco ASR 9912 Router, the two fan trays are located above the line card cage. Each fan tray holds 12 axial fans and includes a controller that reduces the speed of the fans when the chassis temperature is within limits, thereby reducing the generation of acoustic noise. The fan controller also senses and reports individual fan failures.

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 the exhaust is at the upper rear.

Figure 2-64 shows the cooling path of the Cisco ASR 9010 Router chassis.

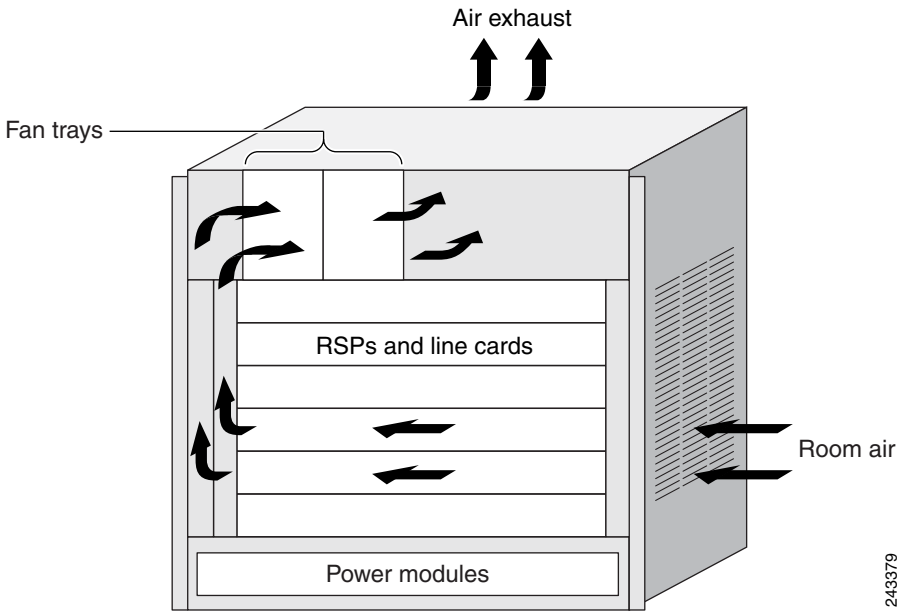
Figure 2-64 Cisco ASR 9010 Router Chassis Cooling Path—Side View



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 the exhaust is at the upper rear.

Figure 2-65 shows the cooling path of the Cisco ASR 9006 Router chassis.

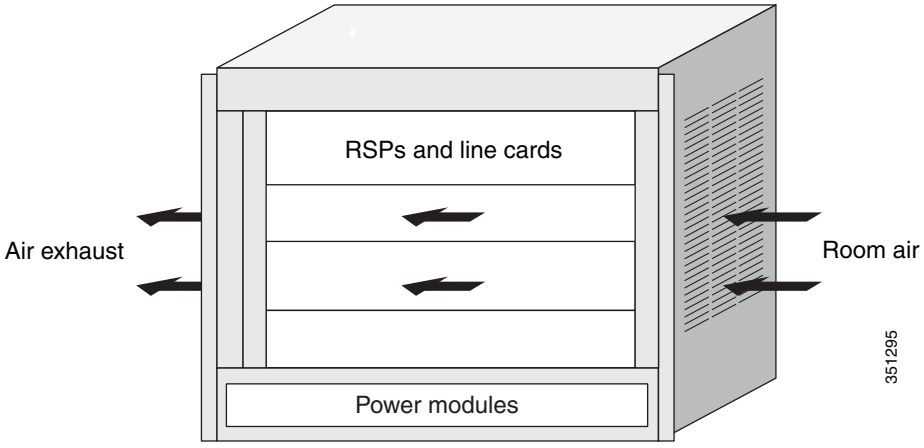
Figure 2-65 Cisco ASR 9006 Router Chassis Cooling Path



The Cisco ASR 9904 Router has a side-to-side cooling path. The inlet is at the right side of the cage, and the exhaust is at the left side.

Figure 2-66 shows the cooling path of the Cisco ASR 9904 Router chassis.

Figure 2-66 Cisco ASR 9904 Router Chassis Cooling Path



The cages of the Cisco ASR 9922 Router chassis have a front-to-rear cooling path. The inlet is at the front of the middle cage, and the exhaust is at the upper and lower rear.

Figure 2-67 and Figure 2-68 show the cooling path of the Cisco ASR 9922 Router chassis.

Figure 2-67 Cisco ASR 9922 Router Chassis Cooling Path—Side View

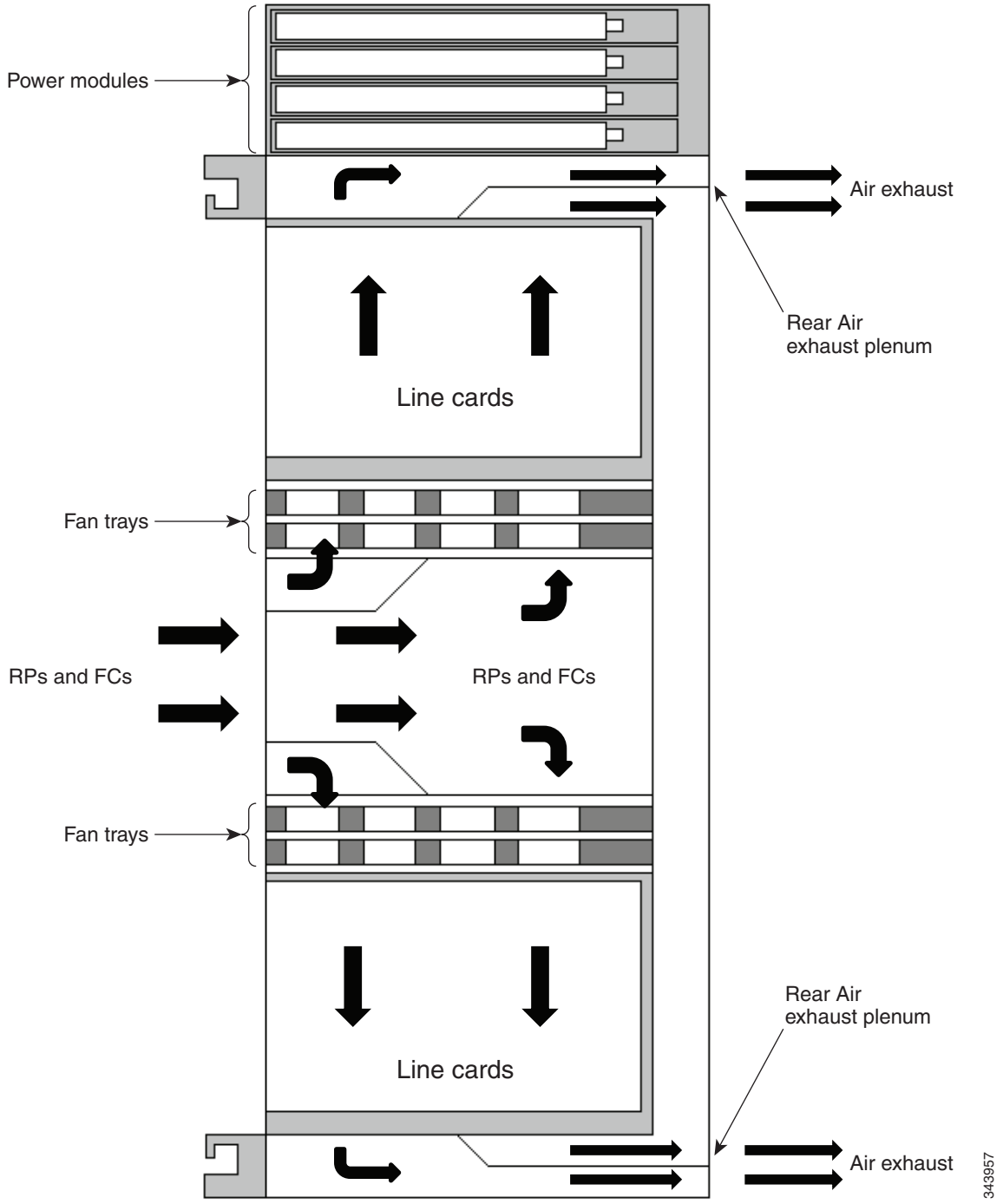
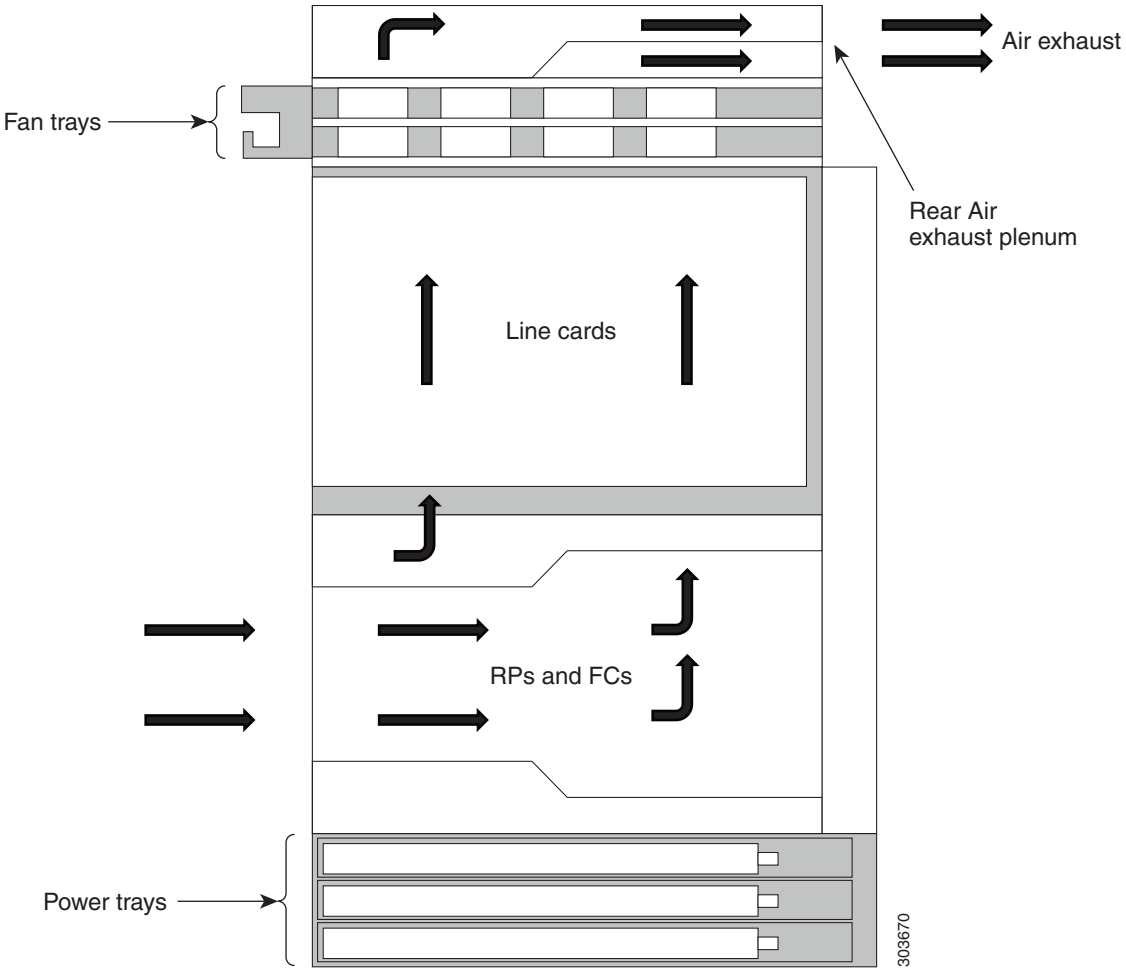


Figure 2-68 Cisco ASR 9912 Router Chassis Cooling Path—Side View

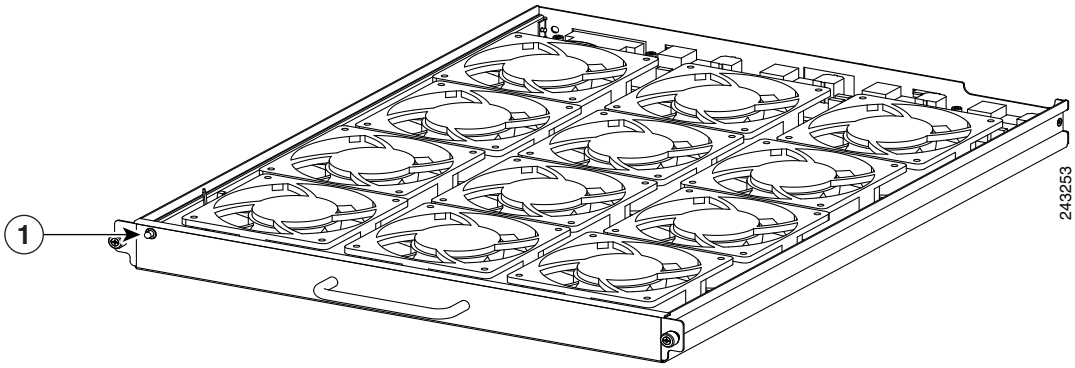


Fan Trays

Cisco ASR 9010 Router Fan Trays

The Cisco ASR 9010 Router contains two fan trays for redundancy (see Figure 2-69). The fan tray has an LED indicator to indicate fan tray status. If a fan tray fails, 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.

Figure 2-69 Cisco ASR 9010 Router Fan Tray



1	Fan tray status LED

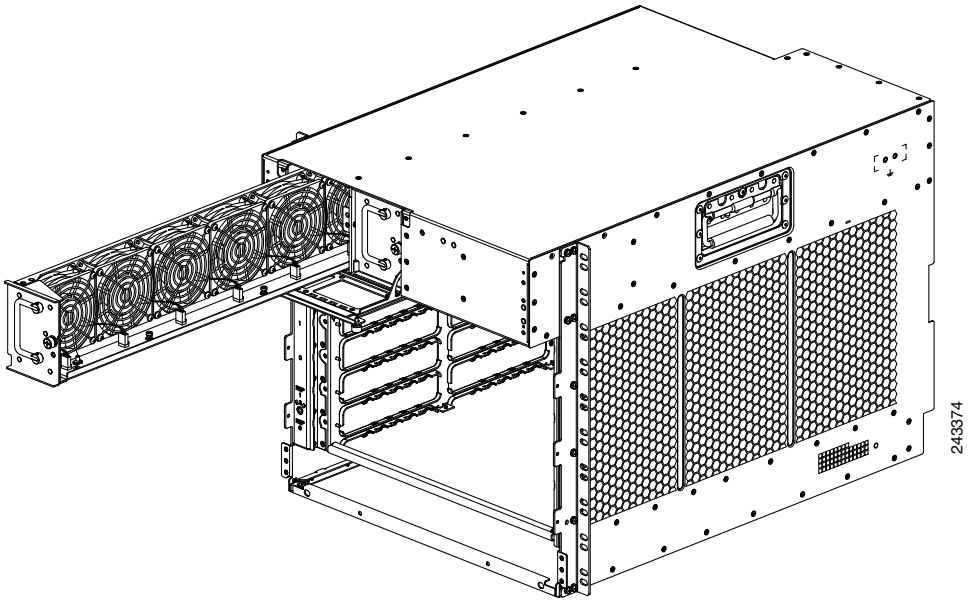
- The fan tray contains 12 axial 120-mm (4.72-in) fans. There is a fan control board at the back end of each tray with a single power/data connector that connects with the backplane.
- The fan tray aligns through two guide pins inside the chassis, and it is secured by two captive screws. The controller board floats within the fan tray to allow for alignment tolerances.
- A finger guard is adjacent to the front of most fans to keep fingers away from spinning fan blades during removal of the fan tray.
- The maximum weight of the fan tray is 13.82 lb (6.29 kg).

Cisco ASR 9006 Router Fan Trays

The Cisco ASR 9006 Router contains two fan trays for redundancy (see Figure 2-70). If a fan tray fails, 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 Both fan trays are required for normal system operation for the Cisco ASR 9010 Router and Cisco ASR 9006 Router. If both fan trays in the router are pulled out or are not installed, a critical alarm is raised.

Figure 2-70 Cisco ASR 9006 Router Fan Tray

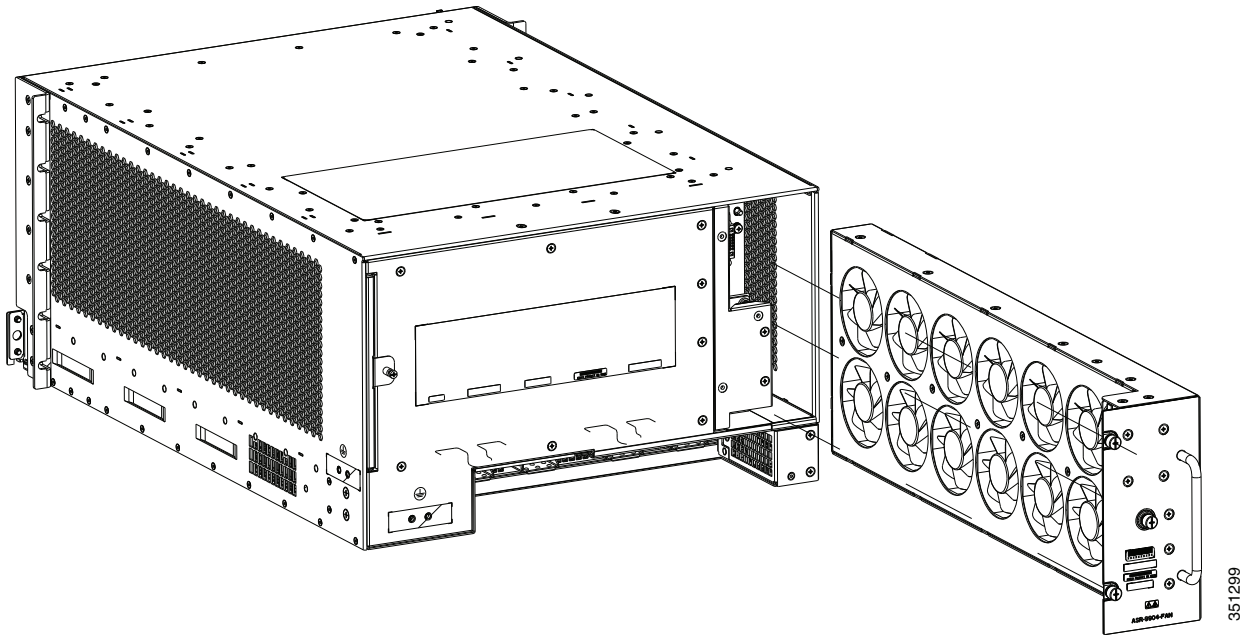


- The fan tray contains six axial 92-mm (3.62-in) fans. There is a fan control board at the back end of each tray with a single power/data connector that connects with the backplane.
- The fan tray aligns through two guide pins inside the chassis, and is secured by one captive screw. The controller board 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.
- The maximum weight of the fan tray is 39.7 lb (18.0 kg).

Cisco ASR 9904 Router Fan Tray

The Cisco ASR 9904 Router contains a single fan tray. If a fan tray fails, it is possible to swap a single fan tray assembly while the system is operational. Replace the missing fan tray within 4 minutes.

Figure 2-71 Cisco ASR 9904 Router Fan Tray



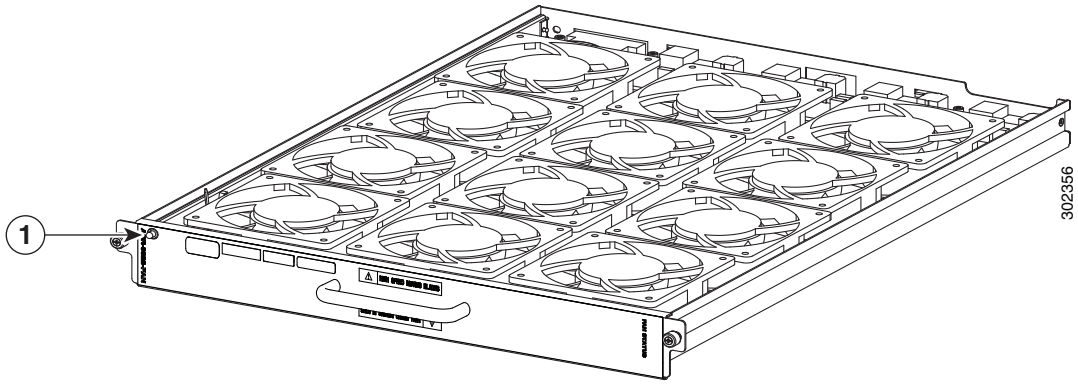
- The fan tray contains twelve axial 88-mm (3.46-in) fans. There is a fan control board at the back end of the tray with a single power/data connector that connects with the backplane
- The fan tray aligns through two guide pins inside the chassis, and it is secured by one captive screw. The controller 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.
- The maximum weight of the fan tray is 11.0 lb (4.99 kg).

Cisco ASR 9922 Router and Cisco ASR 9912 Router Fan Trays

The Cisco ASR 9922 Router contains four fan trays, and the Cisco ASR 9912 Router contains three fan trays for redundancy. The fan tray has an LED indicator to indicate fan tray status. If a fan tray fails, 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 Do not operate the chassis with any of the fan trays completely missing. Replace any missing fan tray within five minutes.

Figure 2-72 Cisco ASR 9922 Router and Cisco ASR 9912 Router Fan Tray



1	Fan tray status LED

- 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 it 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 fans to keep fingers away from spinning fan blades during removal of the fan tray.
- The maximum weight of the fan tray is 18.00 lb (8.16 kg).
- The fan tray width is increased from 16.3 inches to 17.3 inches. The overall fan tray depth remains the same at 23 inches. The individual fan current rating is increased to 2 A to support higher speeds.

Status Indicators

The 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:
  - Fan stopped.
  - Fans running below required speed to maintain sufficient cooling.
  - Controller card has a fault.

Fan Tray Servicing

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

Slot Fillers

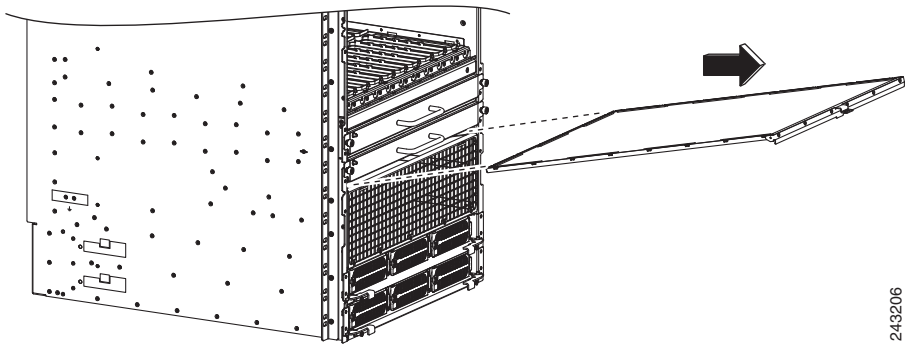
To maintain optimum cooling performance in the chassis and at the slot level, unused slots must be filled with card blanks or flow restrictors. These slot fillers are simple sheet metal only and are not active. Software cannot detect their presence.

Chassis Air Filter

The chassis air filters in the ASR 9000 Series Routers are NEBS compliant. The filter is not serviceable but is a field replaceable unit. Replacing the filter does not interrupt service.

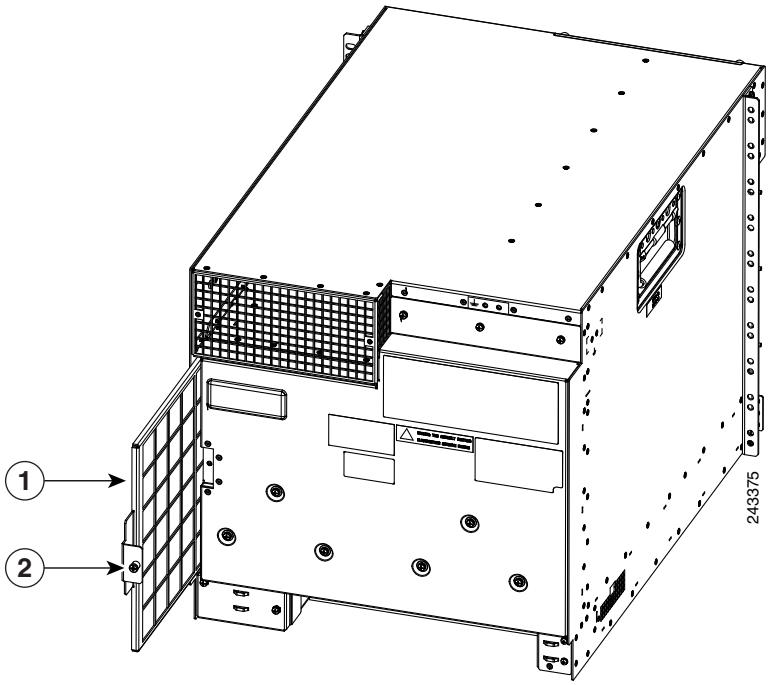
In the Cisco ASR 9010 Router, a chassis air filter is located underneath the fan trays (see Figure 2-73).

Figure 2-73 Cisco ASR 9010 Router Chassis Air Filter



In the Cisco 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 (see Figure 2-74).

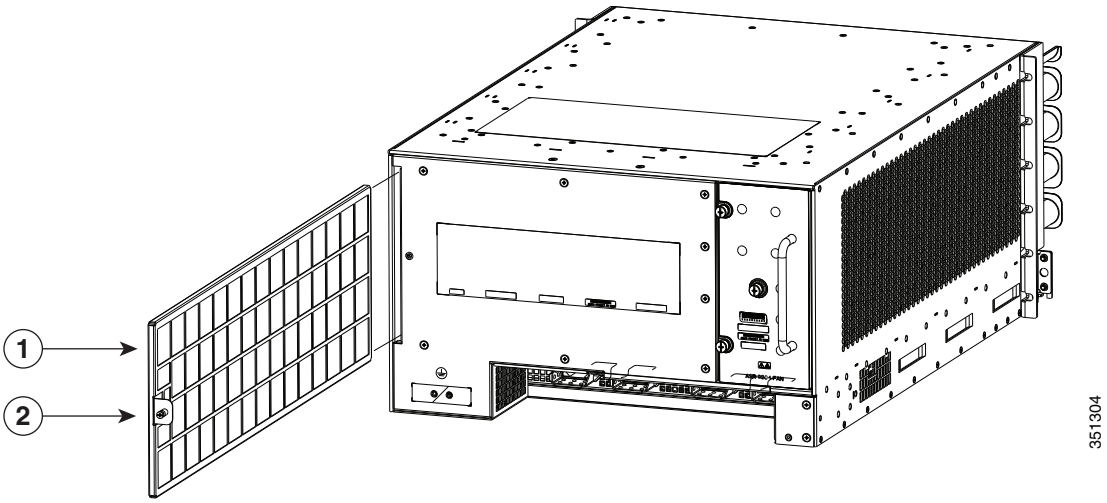
Figure 2-74 Cisco ASR 9006 Router Chassis Air Filter



1	Air filter	2	Thumb screw

In the Cisco ASR 9904 Router, the chassis air filter is located along the right side of the chassis, and is accessible from the rear of the chassis (see Figure 2-75).

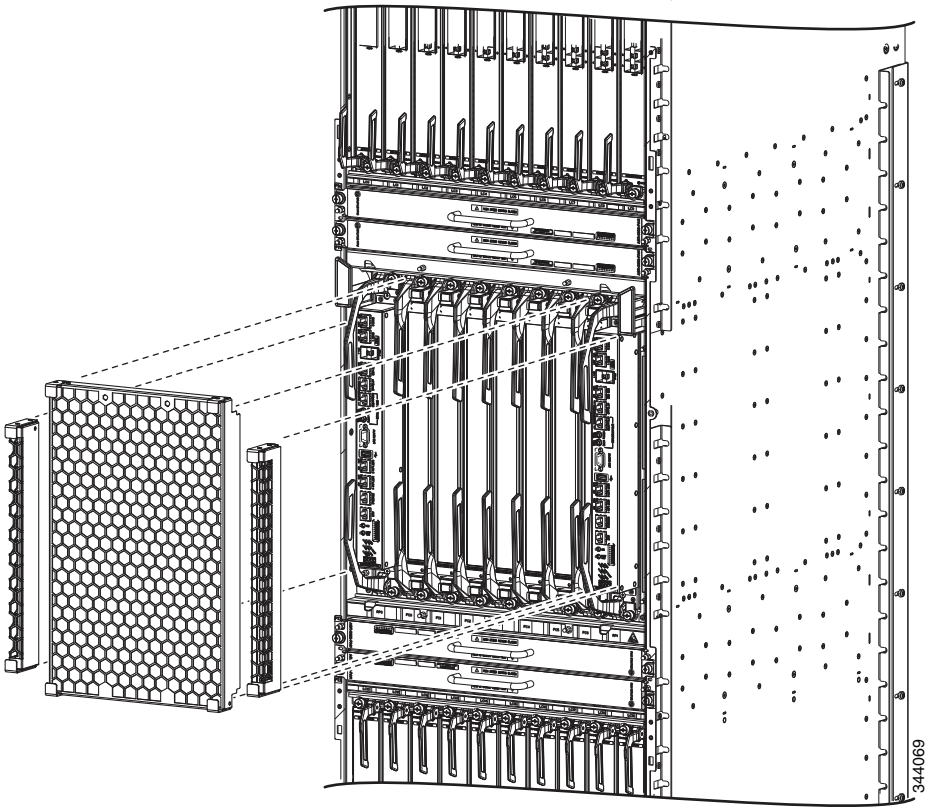
Figure 2-75 Cisco ASR 9904 Router Air Filter



1	Air filter	**2**	Thumb screw

The Cisco ASR 9922 Router has three air filters on the middle cage (see Figure 2-76). The center air filter covers the front of the FC cards. The side air filters cover the RP cards.

Figure 2-76 ASR 9922 Router Chassis Air Filters



The Cisco ASR 9912 Router has three air filters on the RP/FC card cage (see Figure 2-77). The center air filter covers the front of the FC cards. The side air filters cover the RP cards.

Figure 2-77 Cisco ASR 9912 Router Chassis Air Filters

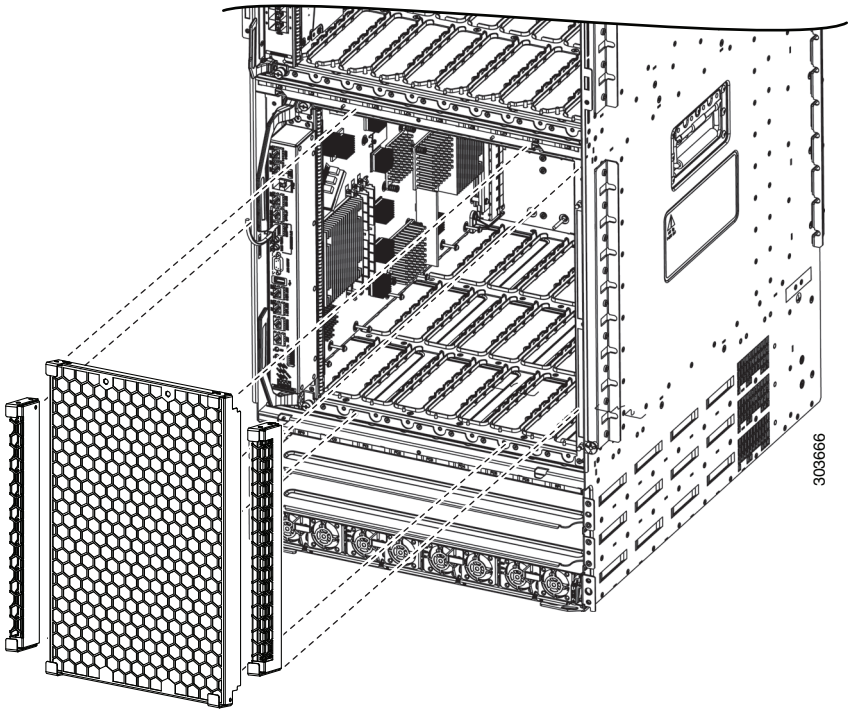
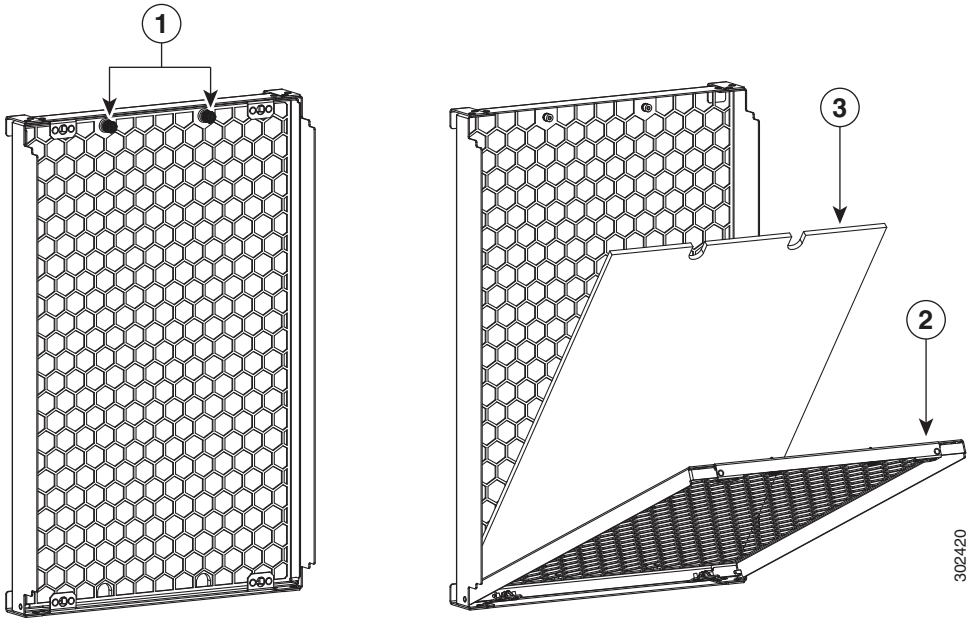


Figure 2-78 shows how to replace the foam media inside the center air filter.

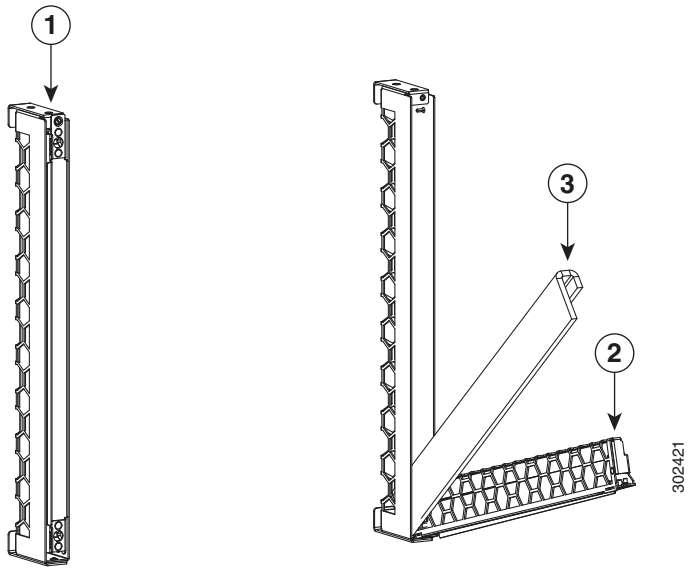
Figure 2-78 Cisco ASR 9922 Router Chassis Center Air Filter



1	Loosen thumb screws.	**3**	Remove foam filter media.
2	Rotate and lower inner frame.		

Figure 2-79 shows how to replace the foam media inside one of the two side air filters.

Figure 2-79 Cisco ASR 9922 Router Chassis Side Air Filter



1	Loosen thumb screws	**3**	Remove foam filter media
2	Rotate and lower inner frame		

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/RP card and the controller card in the fan tray. The RSP/RP 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 causes 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/RP 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 triggers environmental alarms and increases the fan speed of the remaining tray to its maximum speed.

Servicing

The system is populated with two fan trays for redundancy. If a fan tray failure occurs, 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 ASR 9000 Series Routers provides the system manageability interfaces: CLI, XML, and SNMP.

Cisco IOS XR Software

The ASR 9000 Series Routers run Cisco IOS XR Software and use the manageability architecture of that operating system, which includes CLI, XML, and SNMP. 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 ASR 9000 Series Routers support only 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 2-87.

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 ASR 9000 Series Routers support 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 Cisco IOS XR software 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.

MIBs

The Device Management MIBs supported by the ASR 9000 Series Routers are listed at:

http://cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml

Online Diagnostics

System run-time diagnostics are used by the Cisco Technical Assistance Center (TAC) 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/RP card communication paths
- Monitoring line card to RSP/RP card data path
- Monitoring CPU communication with various components on the line cards and RSP/RP cards

High Availability and Redundant Operation

This chapter describes the high availability and redundancy features of the Cisco ASR 9000 Series 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 Routers offer the following high availability (HA) features to enhance network level resiliency and enable network-wide protection:

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

High Availability Router Operations

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

Stateful Switchover

The RSP/RP cards are deployed in “active/standby” configurations. Stateful switchover (SSO) preserves state and configuration information if a switchover to the standby RSP/RP card occurs. The standby RSP/RP 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/RP card, the standby RSP/RP card changes state to become the active RSP/RP card. This stateful switchover has no impact in forwarding traffic.

Fabric Switchover

In the Cisco ASR 9010 Router, Cisco ASR 9006 Router, and Cisco ASR 9904 Router, 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 continues to forward traffic in the systems.

In the Cisco ASR 9922 Router and Cisco ASR 9912 Router, fabric switching across the RP and line cards is provided by a separate set of seven OIR FC cards operating in 6+1 redundancy mode. Any FC card can be removed from the chassis, power-cycled, or provisioned to remain unpowered without impacting system traffic. All FC cards remain active unless disabled or faulty. Traffic from the line cards is distributed across all FC cards.

Active/Standby Status Interpretation

Status signals from each RSP/RP card are monitored to determine active/standby status and if a failure has occurred that requires a switchover from one RSP/RP 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/RP card to the standby RSP/RP card after the RSP/RP switchover without letting peers know about the switchover. The sessions terminate and the protocols running on the standby RSP/RP card reestablish the sessions after the standby RSP/RP goes active. NSR can also be used with graceful restart to protect the routing control plane during switchovers. The NSR functionality is available only for Open Shortest Path First Protocol (OSPF) and Label Distribution Protocol (LDP) routing technologies.

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 before a 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

To minimize service outage, the Cisco ASR 9000 Series Routers provide rapid and efficient response to single or multiple system component or network failures 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 Cisco ASR 9000 Series Routers offer 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 Cisco 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—Cisco ASR 9000 Series Routers support 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—Cisco ASR 9000 Series Routers provide 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—Cisco ASR 9000 Series Routers offer 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 such 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 a power module is detected, and an alarm raised.

AC Power Redundancy

The AC power modules are a modular design allowing replacement without any outage. Figure 3-1 shows the minimum and maximum module configurations for version 1 power modules. Figure 3-2 shows that version 2 is similar, with a minimum of one module per tray.

At least one fully loaded AC tray is required to power a fully loaded system. Each module outputs 3000 W.

For Cisco ASR 9010 Routers, the slot location of a module in the power trays is irrelevant as long as the two power trays have an equal number of modules installed (in case one tray should fail) (see Figure 3-1).

For Cisco ASR 9006 Routers and Cisco ASR 9904 Routers the slot location of a module in the tray is irrelevant as long as there are N+1 number of modules (see Figure 3-3 and Figure 3-4).

Figure 3-1 AC System Power Redundancy for the Cisco ASR 9010 Router—Version 1

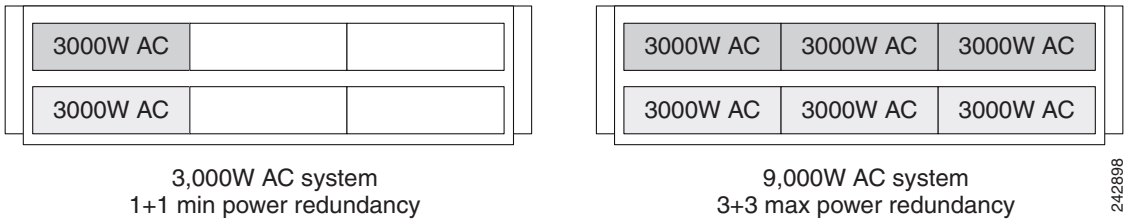


Figure 3-2 AC System Power Redundancy for the Cisco ASR 9010 Router—Version 2

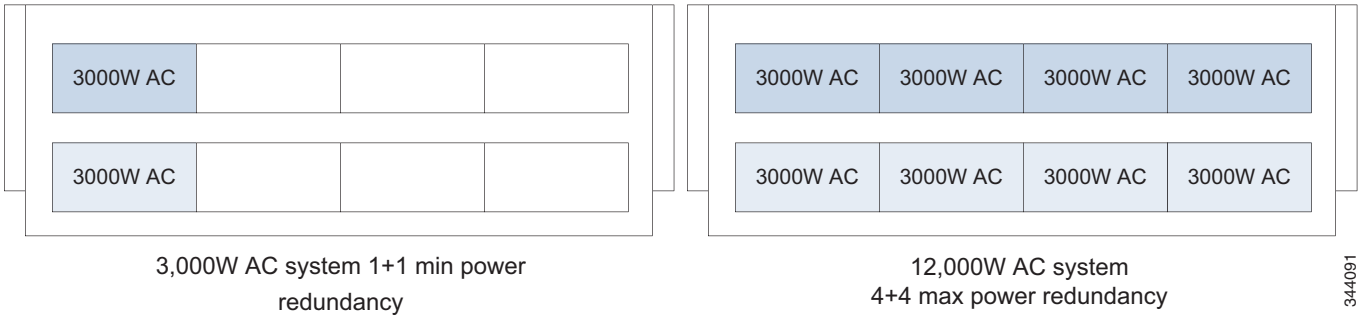


Figure 3-3 AC System Power Redundancy for the Cisco ASR 9006 Router—Version 2

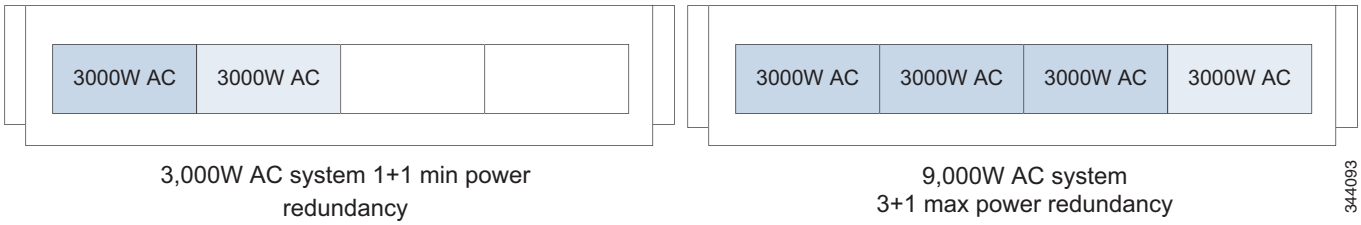


Figure 3-4 AC System Power Redundancy for the Cisco ASR 9904 Router—Version 2

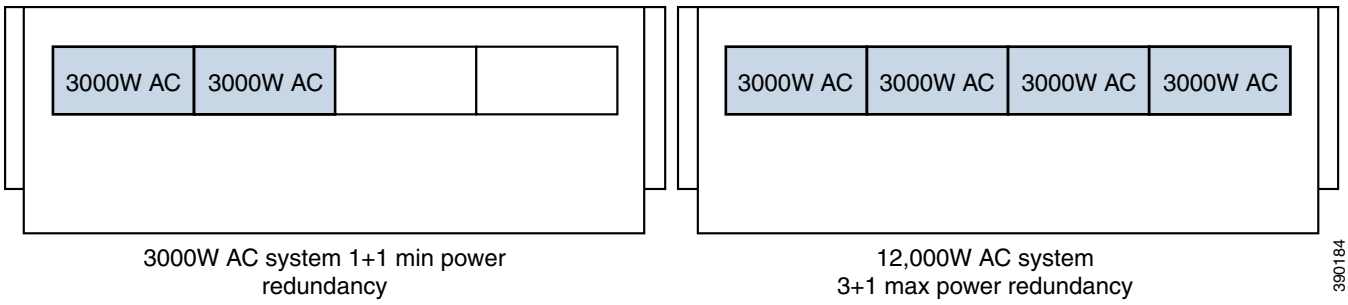


Figure 3-5 AC System Power Redundancy for the Cisco ASR 9922 Router—Version 2

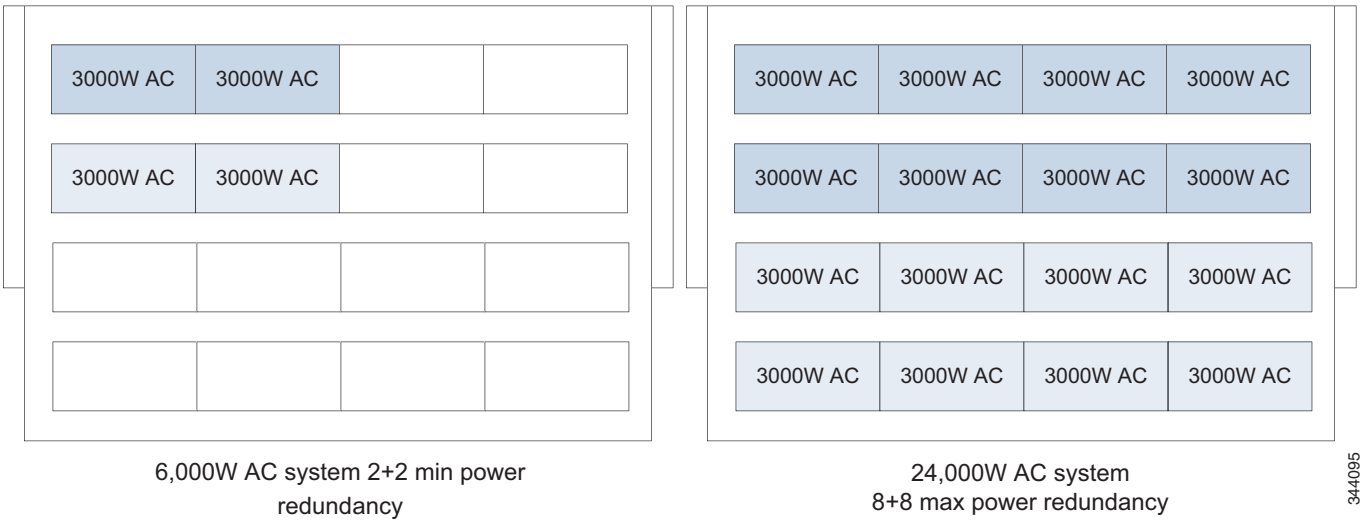
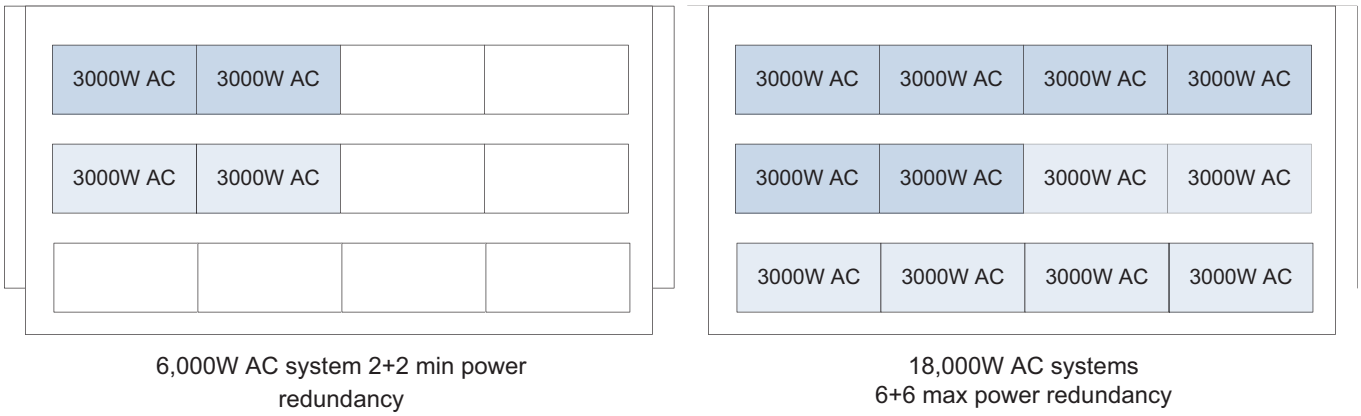


Figure 3-6 AC System Power Redundancy for the Cisco ASR 9912 Router—Version 2



Note The Cisco ASR 9010 Router, Cisco ASR 9922 Router, and Cisco ASR 9912 Router are capable of operating with power modules installed in only one of their power trays. However, such a configuration does not provide any redundancy.

Note AC power redundancy for the Cisco ASR 9010 Router, Cisco ASR 9922 Router, and Cisco ASR 9912 Router requires that power modules be installed in multiple power trays.

DC Power Redundancy

The DC power modules are a modular design allowing replacement without any outage. Each tray houses up to three version 1 power modules or four version 2 power modules. Figure 3-7 shows the minimum and maximum module configurations for the version 1 power modules. Figure 3-8 shows that version 2 is similar, with a minimum of one module per tray.

The Cisco ASR 9000 Series Routers have two available DC power modules, a 2100 W module and a 1500 W module. Both types of power modules can be used in a single chassis. See Appendix A, "Technical Specifications," for power module specifications.

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

Figure 3-7 DC System Power Redundancy for the Cisco ASR 9010 Router—Version 1

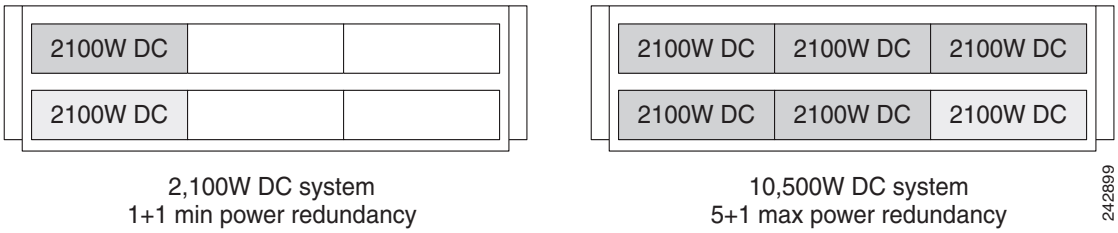


Figure 3-8 DC System Power Redundancy for the Cisco ASR 9010 Router—Version 2

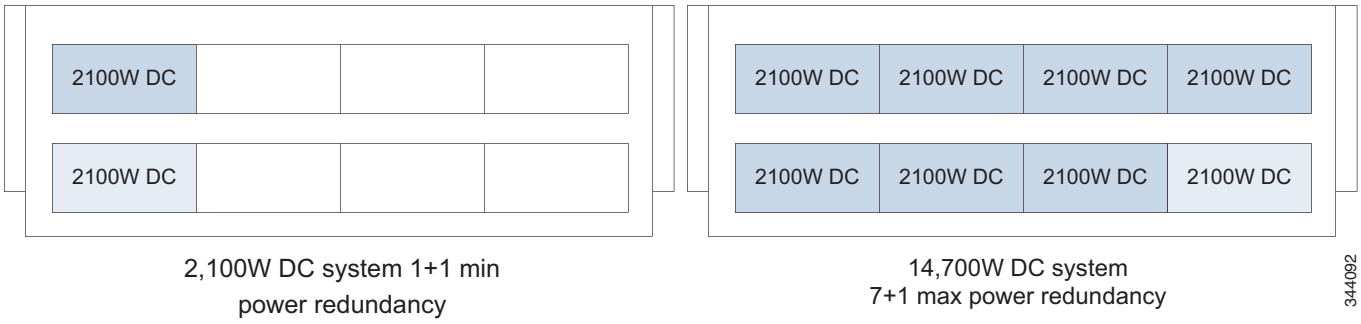


Figure 3-9 DC System Power Redundancy for the Cisco ASR 9006 Router Version—2

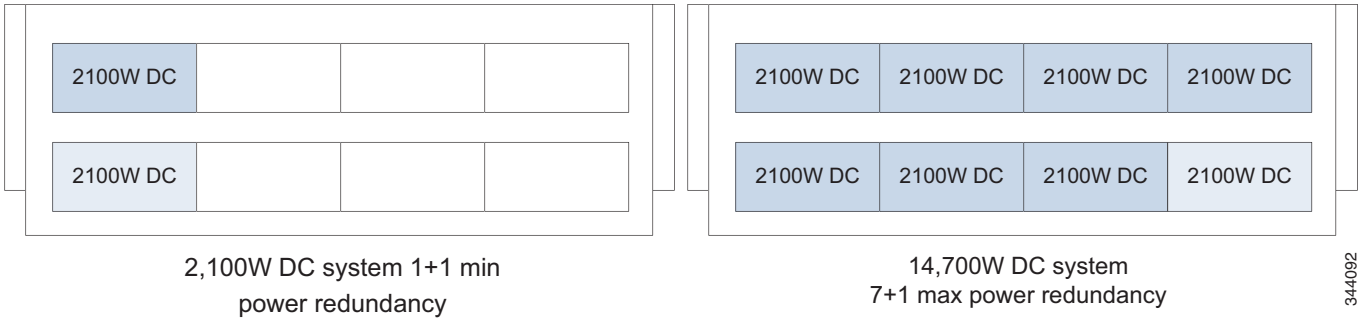


Figure 3-10 DC System Power Redundancy for the Cisco ASR 9904 Router—Version 2

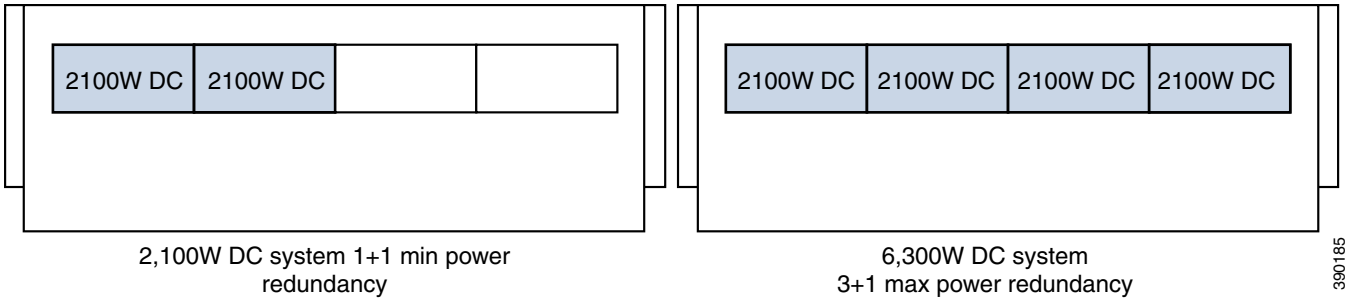


Figure 3-11 DC System Power Redundancy for the Cisco ASR 9922 Router—Version 2

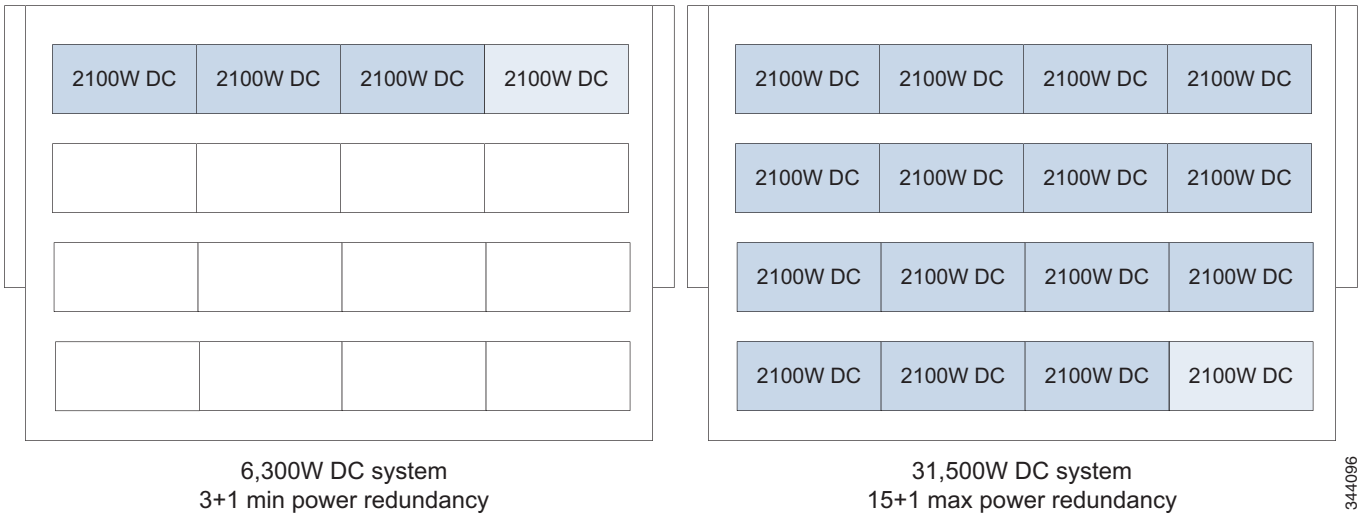
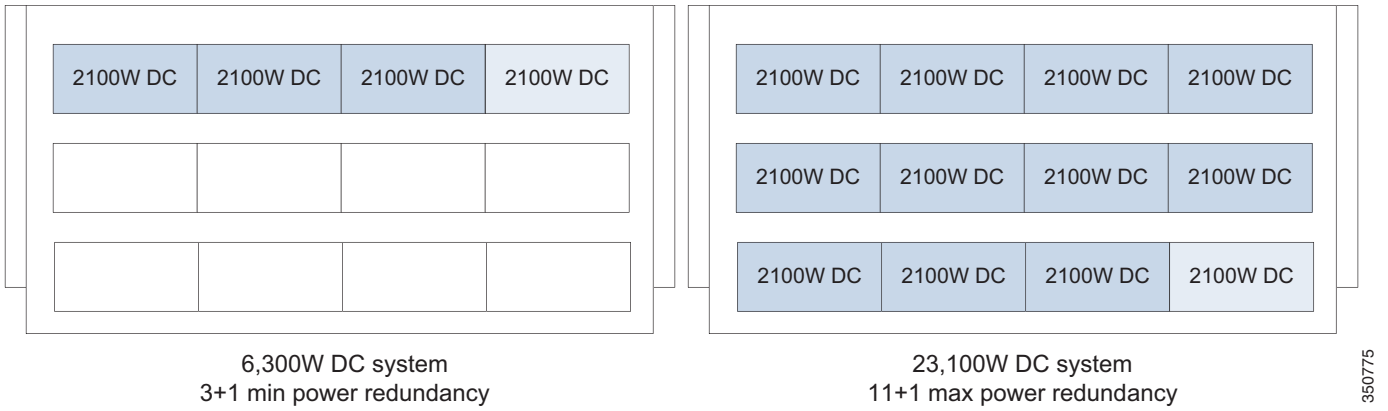


Figure 3-12 DC System Power Redundancy for the Cisco ASR 9912 Router—Version 2



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 tray. For maximum diversity, the power entry point to each tray is spatially separated to the left and right edges of the tray. Each feed can support the power consumed by the entire tray. There is load sharing between the feeds. Each power module in the tray 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 tray. 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 always has 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 always has two fans operating to compensate for the air speed.

The Cisco ASR 9904 Router has a single fan tray located at the left side of the chassis and is accessible from the rear. The fan tray has 12 fans arranged in three groups of four fans each. Two fans in 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 eleven fans will compensate for it. If a fan controller fails, there is a possibility of up to two fans failing; however, the design always has two fans operating to compensate for the air speed.

In the Cisco ASR 9922 Router, the two top fan trays are located between the top and middle card cages, while the two bottom fan trays are located between the middle and bottom card cages. In the Cisco ASR 9912 Router, the two fan trays are located above the line card cage. 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 always has two fans operating in a row (three rows of fans) to compensate for the air speed.

Caution If only one fan tray is installed in the system, one single point of failure does 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 and the system crosses the Shutdown Temperature Threshold (STT).

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/RP 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/RP card also has two sensors.

Technical Specifications

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

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

Table A-1 Cisco ASR 9010 Router Physical Specifications

Description	Value
Chassis height	36.75 inches (93.35 cm)
Chassis width	17.50 inches (44.45 cm) 19.0 inches (48.3 cm) including chassis rack-mount flanges and front door width
Chassis depth	28.65 inches (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.

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

Table A-2 Cisco ASR 9006 Router Physical Specifications

Description	Value
Chassis height	17.50 inches (44.45 cm)
Chassis width	17.50 inches (44.45 cm) 19.0 inches (48.3 cm) including chassis rack-mount flanges and front door width
Chassis depth	28.65 inches (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 physical specifications for the Cisco ASR 9904 Router.

Table A-3 Cisco ASR 9904 Router Physical Specifications

Description	Value
Chassis height	10.38 inches (26.36 cm)
Chassis width	17.75 inches (45.08 cm) 19.0 inches (48.3 cm) including chassis rack-mount flanges
Chassis depth	28.26 inches (71.78 cm) including cable management system
Chassis weight	
• Chassis only[1]	43.3 pounds (19.64 kg)
• Chassis: fully configured using all card slots and four power modules	122.8 pounds (55.70 kg)

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

Table A-4 lists the physical specifications for the Cisco ASR 9922 Router.

Table A-4 Cisco ASR 9922 Router Physical Specifications

Description	Value
Chassis height	77.00 inches (195.58 cm)
Chassis width	17.60 inches (44.70 cm) 19.0 inches (48.3 cm) including chassis rack-mount flanges and front door width
Chassis depth	26.3 inches (66.82 cm) 30.00 inches (76.20 cm) including cable management system 30.62 inches (77.77 cm) with front doors
Chassis weight	
• Chassis only[1]	300 pounds (136 kg)
• Chassis: fully configured using all card slots and four power trays	1038 pounds (470.28 kg)

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

Table A-5 lists the physical specifications for the Cisco ASR 9912 Router.

Table A-5 Cisco ASR 9912 Router Physical Specifications

Description	Value
Chassis height	52.5 inches (133.4 cm)
Chassis width	17.6 inches (44.7 cm) 19.0 inches (48.3 cm) including chassis rack-mount flanges and front doors
Chassis depth	25.7 inches (65.2 cm) 29.4 inches (74.7 cm) including cable management system 30.1 inches (76.4 cm) including cable management system and front doors
Chassis weight	
• Chassis only[1]	181 pounds (82.10 kg)
• Chassis: fully configured using all card slots and three power trays	643 pounds (291.66 kg)

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

Table A-6 lists the environmental specifications for the Cisco ASR 9000 Series Routers.

Table A-6 Cisco ASR 9000 Series Environmental Specifications

Description	Value
Operating Temperature:[1]	41 to 104°F (5 to 40°C)
Operating Temperature[1,2] (Short term)[3,4]:	• 23 to 131° F (-5° to 55°C) for Cisco ASR 9904 Router • 23 to 131° F (–5° to 55°C) for Cisco ASR 9006 Router • 23 to 122° F (–5° to 50°C) for Cisco ASR 9010 Router Cisco ASR 9922 Router, and Cisco ASR 9912 Router
Non-operating Temperature	-40 to 158ºF (-40 to 70ºC)
Humidity	Operating: 10 to 85 percent noncondensing Non-operating: 5 to 95 percent noncondensing
Altitude[5]	Operating: 0 to 13,000 ft. (0 to 4,000 m) Non-operating: 0 to 15,000 ft (0 to 4,570 m) 16-port 10-Gigabit Ethernet line card: 0 to 5,904 ft (0 to 1,800 m)
Power Dissipation	All Cisco ASR 9000 Series Routers Use the Cisco Power Calculator (Cisco.com account required) at http://tools.cisco.com/cpc/launch.jsp to estimate the maximum power distribution.
Acoustic noise	78 dB at 80.6°F (27°C) maximum

Table A-6 Cisco ASR 9000 Series Environmental Specifications (continued)

Description	Value
Shock	Operating (halfsine): 21 in/sec (0.53 m/sec.) Non-operating (trapezoidal pulse): 20 G[6], 52 in/sec (1.32 m/sec)
Vibration	Operating: 0.35 Grms[7] from 3 to 500 Hz Non-operating: 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. Short term operating temperature specifications for the router will differ from those listed in this table when the 16-port 10-Gigabit Ethernet line card is installed in the router because of the lower temperature specifications of the SFP+ modules that are used in this line card. When using this line card, the maximum operating temperature is 104°F (40°C).
3. Short-term refers to a period of not more than 96 consecutive hours and a total of no more than 15 days in 1 year. (This refers to a total of 360 hours in any given year, but no more than 15 occurrences during that 1-year period.).
4. The 24 port 10 Gigabit Ethernet linecard requires high temperature optics to run in the extended temperature range.
5. Operating altitude specifications for the router will differ from those listed in this table when the 16-port 10-Gigabit Ethernet line card is installed in the router. When using the SFP-10G-SR module, the maximum altitude is 5905 ft. (1800 m). When using the SFP-10G-LR or SFP-10G-ER modules, the maximum altitude is sea level.
6. G is a value of acceleration, where 1 G equals 32.17 ft./sec^2 (9.81 m/sec^2).
7. Grms is the root mean square value of acceleration.

Table A-7 lists the AC electrical specifications for the Cisco ASR 9010 Router.

Table A-7 Cisco ASR 9010 Router AC Electrical Specifications

Description	Value
Power modules per system	Version 1 power system: Up to six AC power modules per system, three per tray Version 2 power system: Up to eight AC power modules per system, four per tray
Total AC input power per power module	3400 VA (volt-amps)
Rated input voltage per power module	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 draw[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 modules (two per power tray) are required for 2N redundancy for a fully configured system (version 1 and version 2).

1. For each AC power supply module. Some power/chassis configurations may operate at lower current ratings than those specified in this table. Contact your Cisco technical representative for more information.

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.

Table A-8 lists the AC electrical specifications for the Cisco ASR 9006 Router.

Table A-8 Cisco ASR 9006 Router AC Electrical Specifications

Description	Value
Power modules per system	Version 1 power system: Up to three AC power modules per system Version 2 power system: Up to four AC power modules per system
Total AC input power per power module	3400 VA (volt-amps) per AC power module
Rated input voltage per power module	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 draw[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 United Kingdom
Redundancy	At least two AC power modules are required for N+1 redundancy for a fully configured system (version 1 and version 2).

1. For each AC power supply module. Some power/chassis configurations may operate at lower current ratings than those specified in this table. Contact your Cisco technical representative for more information.

Table A-9 lists the AC electrical specifications for the Cisco ASR 9904 Router.

Table A-9 Cisco ASR 9904 Router AC Electrical Specifications

Description	Value
Power modules per system	Version 2 power system: Up to four AC power modules per system
Total AC input power per power module	3400 VA (volt-amps) per AC power module
Rated input voltage per power module	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 draw[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 United Kingdom
Redundancy	At least two AC power modules are required for N+1 redundancy for a fully configured system.

1. For each AC power supply module. Some power/chassis configurations may operate at lower current ratings than those specified in this table. Contact your Cisco technical representative for more information.

Both the AC-powered and DC-powered versions of the Cisco ASR 9904 Router support only version 2 power systems.

Table A-10 lists the AC electrical specifications for the Cisco ASR 9922 Router.

Table A-10 Cisco ASR 9922 Router AC Electrical Specifications

Description	Value
Power modules per system	Version 2 power system: Up to 16 AC power modules per system, four per tray
Total AC input power per power module	3400 VA (volt-amps)
Rated input voltage per power module	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 draw[1]	15 A maximum at 200 VAC 13 A maximum at 220 to 240 VRMS (UK)

Table A-10 Cisco ASR 9922 Router AC Electrical Specifications

Description	Value
Source AC service requirement[1]	20 A North America; 16 A international; 13 A UK
Redundancy	AC power modules operate in N+N redundancy mode. Up to sixteen AC power modules are supported. The number of AC power modules needed depends on the configuration of the chassis (e.g. number of line cards, RPs, and FC cards installed). Use the Cisco Power Calculator (Cisco.com account required) at http://tools.cisco.com/cpc/launch.jsp to calculate how many AC power modules are needed.

1. For each AC power supply module. Some power/chassis configurations may operate at lower current ratings than those specified in this table. Contact your Cisco technical representative for more information.

Both the AC-powered and DC-powered versions of the Cisco ASR 9922 Router support only version 2 power systems.

Table A-11 lists the AC electrical specifications for the Cisco ASR 9912 Router.

Table A-11 Cisco ASR 9912 Router AC Electrical Specifications

Description	Value
Power modules per system	Version 2 power system: Up to 12 AC power modules per system, four per tray
Total AC input power per power module	3400 VA (volt-amps)
Rated input voltage per power module	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 draw[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	AC power modules operate in N+N redundancy mode. Up to 12 AC power modules are supported. The number of AC power modules needed depends on the configuration of the chassis (e.g. number of line cards, RPs, and FC cards installed). Use the Cisco Power Calculator (Cisco.com account required) at http://tools.cisco.com/cpc/launch.jsp to calculate how many AC power modules are needed.

1. For each AC power supply module. Some power/chassis configurations may operate at lower current ratings than those specified in this table. Contact your Cisco technical representative for more information.

Both the AC-powered and DC-powered versions of the Cisco ASR 9912 Router support only Version 2 power systems.

Table A-12 lists the DC electrical specifications for the Cisco ASR 9010 Router.

Table A-12 Cisco ASR 9010 Router DC Electrical Specifications

Description	Value
Power modules per system	Version 1 power system Up to six DC power modules per system, three per tray Version 2 power system: Up to eight DC power modules per system, four per tray
Total DC input power per power module	Version 1: 1700 W (1500 W output module) Version 2: 2300 W (2100 W output module)
Rated input voltage per power module	–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 draw[1]	49 A maximum at –48 VDC nominal 39 A maximum at –60 VDC nominal
Source DC service requirement[1]	Sufficient to supply the rated input current. Local codes apply.
Redundancy	At least four DC power modules (two per power tray) are required for N+1 redundancy for a fully configured system (version 1 and version 2).

1. For each DC power supply module. Some power/chassis configurations may operate at lower current ratings than those specified in this table. Contact your Cisco technical representative for more information.

Table A-13 lists the DC electrical specifications for the Cisco ASR 9006 Router.

Table A-13 Cisco ASR 9006 Router DC Electrical Specifications

Description	Value
Power modules per system	Version 1 power system Up to three DC power modules per system Version 2 power system: Up to four DC power modules per system
Total DC input power per power module	Version 1 power system 1700 W (1500 W output module) Version 2 power system 2300 W (2100 W output module)
Rated input voltage per power module	–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 draw[1]	49 A maximum at –48 VDC nominal 39 A maximum at –60 VDC nominal

Table A-13 Cisco ASR 9006 Router DC Electrical Specifications (continued)

Description	Value
Source DC service requirement[1]	Sufficient to supply the rated input current. Local codes apply.
Redundancy	At least two DC power modules are required for N+1 redundancy for a fully configured system (version 1 and version 2).

1. For each DC power supply module. Some power/chassis configurations may operate at lower current ratings than those specified in this table. Contact your Cisco technical representative for more information.

Table A-14 lists the DC electrical specifications for the Cisco ASR 9904 Router.

Table A-14 Cisco ASR 9904 Router DC Electrical Specifications

Description	Value
Power modules per system	Version 2 power system: Up to four DC power modules per system
Total DC input power per power module	Version 2 power system: 2300 W (2100 W output module)
Rated input voltage per power module	–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 draw[1]	49 A maximum at –48 VDC nominal 39 A maximum at –60 VDC nominal
Source DC service requirement[1]	Sufficient to supply the rated input current. Local codes apply.
Redundancy	At least two DC power modules are required for N+1 redundancy for a fully configured system.

1. For each DC power supply module. Some power/chassis configurations may operate at lower current ratings than those specified in this table. Contact your Cisco technical representative for more information.

Table A-15 lists the DC electrical specifications for the Cisco ASR 9922 Router.

Table A-15 Cisco ASR 9922 Router DC Electrical Specifications

Description	Value
Power modules per system	Version 2 power system: Up to 16 DC power modules per system, four per tray
Total DC input power per power module	Version 2 power system 2300 W (2100 W output module)
Rated input voltage per power module	–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 draw[1]	49 A maximum at –48 VDC nominal 39 A maximum at –60 VDC nominal

Table A-15 Cisco ASR 9922 Router DC Electrical Specifications (continued)

Description	Value
Source DC service requirement[1]	Sufficient to supply the rated input current. Local codes apply.
Redundancy	DC power modules operate in N+1 redundancy mode. Up to sixteen DC power modules are supported. The number of DC power modules needed depends on the configuration of the chassis (e.g. number of line cards, RPs, and FC cards installed). Use the Cisco Power Calculator (Cisco.com account required) at http://tools.cisco.com/cpc/launch.jsp to calculate how many DC power modules are needed.

1. For each DC power supply module. Some power/chassis configurations may operate at lower current ratings than those specified in this table. Contact your Cisco technical representative for more information.

Both the AC-powered and DC-powered versions of the Cisco ASR 9922 Router support only version 2 power systems.

Table A-16 lists the DC electrical specifications for the Cisco ASR 9912 Router.

Table A-16 Cisco ASR 9912 Router DC Electrical Specifications

Description	Value
Power modules per system	Version 2 power system: Up to 12 DC power modules per system, four per tray
Total DC input power per power module	Version 2 power system: 2300 W (2100 W output module)
Rated input voltage per power module	–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 draw[1]	49 A maximum at –48 VDC nominal 39 A maximum at –60 VDC nominal
Source DC service requirement[1]	Sufficient to supply the rated input current. Local codes apply.
Redundancy	DC power modules operate in N+1 redundancy mode. Up to 12 DC power modules are supported. The number of DC power modules needed depends on the configuration of the chassis (e.g. number of line cards, RPs, and FC cards installed). Use the Cisco Power Calculator (Cisco.com account required) at http://tools.cisco.com/cpc/launch.jsp to calculate how many DC power modules are needed.

1. For each DC power supply module. Some power/chassis configurations may operate at lower current ratings than those specified in this table. Contact your Cisco technical representative for more information.

Both the AC-powered and DC-powered versions of the Cisco ASR 9912 Router support only version 2 power systems.

Table A-17 lists the AC input voltage range for the AC-powered Cisco ASR 9000 Series Routers (single-phase power source).

Table A-17 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-18 lists the DC input voltage range for the DC-powered Cisco ASR 9000 Series Routers.

Table A-18 DC Input Voltage Range

Range	Minimum	Nominal	Maximum
Input Voltage	–40 VDC	–48 VDC	–72 VDC

Table A-19 lists the DC output tolerances for AC or DC power modules for the version 1 power system.

Table A-19 DC Output Levels for Version 1 Power System

Parameter	Value
Voltage	
Maximum	–54.5 VDC
Nominal	–54.0 VDC
Minimum	–53.5 VDC
Power	
Minimum (one power module)	1500 W
Maximum (three 2100 W power modules per tray x two trays)	12,600 W (Cisco ASR 9010 Router only)[1]
Maximum (three 2100 W power modules in a single tray)	6300 W (Cisco ASR 9006 Router only)

1. Maximum output power the power system is capable of supporting (not system power consumption).

Table A-20 lists the DC output tolerances for AC or DC power modules for the version 2 power system.

Table A-20 DC Output Levels for Version 2 Power System

Parameter	Value
Voltage	
Maximum	–55.5 VDC
Nominal	–54.0 VDC
Minimum	–52.5 VDC
Power	
Minimum (one power module)	2100 W
Maximum (four 2100 W power modules in a single tray)[1]	8400 W (Cisco ASR 9006 Router and Cisco ASR 9904 Router)
Maximum (four 2100 W power modules per tray x two trays)	16,800 W (Cisco ASR 9010 Router only)
Maximum (four 2100 W power modules per tray x four trays)	33,600 W (Cisco ASR 9922 Router only)

1. Maximum output power the power system is capable of supporting (not system power consumption).

Table A-21 lists the RSP/RP port specifications.

Table A-21 RSP/RP Port Specifications

Description	Value
Console port	EIA/TIA-232 RJ-45 interface, 9600 Baud, 8 data, no parity, 2 stop bits with flow control none (default)
Auxiliary port	EIA/TIA-232 RJ-45 interface, 9600 Baud, 8 data, no parity, 1 stop bit with software handshake (default)
Management ports (0, 1)	Dual-speed (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

Table A-22 lists the power consumption specifications for the RSP card, RP card, FC card, line cards, and fan tray.

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.

Note The fan tray power consumption numbers reflect the power budget for a single fan tray.

Table A-22 Card and Fan Tray Power Consumption Specifications

Description	Value
RSP Card	
Power consumption	175 W at 77°F (25°C) 205 W at 104°F (40°C) 235 W at 131°F (55°C)
RSP-440 Card	
Power consumption	285 W at 77°F (25°C) 350 W at 104°F (40°C) 370 W at 131°F (55°C)
RP Card	
Power consumption	227 W at 77°F (25°C) 251 W at 104°F (40°C) 259 W at 131°F (55°C)
FC Card (ASR 9922)	
Power consumption	135 W at 77°F (25°C) 147 W at 104°F (40°C) 160 W at 131°F (55°C)
FC Card (ASR 9912)	
Power consumption	80 W at 77°F (25°C) 82 W at 104°F (40°C) 88 W at 131°F (55°C)
8-Port 10-Gigabit Ethernet 2:1 Oversubscribed Line Card	
Power consumption	310 W at 77°F (25°C) 320 W at 104°F (40°C) 350 W at 131°F (55°C)
4-Port 10-Gigabit Ethernet Line Card	
Power consumption	310 W at 77°F (25°C) 320 W at 104°F (40°C) 350 W at 131°F (55°C)

Table A-22 Card and Fan Tray Power Consumption Specifications (continued)

Description	Value
40-port Gigabit Ethernet Line Card	
Power consumption	310 W at 77°F (25°C) 320 W at 104°F (40°C) 350 W at 131°F (55°C)
8-port 10-Gigabit Ethernet 80-Gbps Line Rate Card	
Power consumption	565 W at 77°F (25°C) 575 W at 104°F (40°C) 630 W at 131°F (55°C)
2-port 10-Gigabit Ethernet + 20-port Gigabit Ethernet Combination Line Card	
Power consumption	315 W at 77°F (25°C) 326 W at 104°F (40°C) 335 W at 131°F (55°C)
16-port 10-Gigabit Ethernet Oversubscribed Line Card	
Power consumption	565 W at 77°F (25°C) 575 W at 104°F (40°C) 630 W at 131°F (55°C)
24-port 10-Gigabit Ethernet Line Card	
Power consumption	775 W at 77°F (25°C) 850 W at 104°F (40°C) 895 W at 131°F (55°C)
36-port 10-Gigabit Ethernet Line Card	
Power consumption	850 W at 77°F (25°C) 860 W at 104°F (40°C) 920 W at 131°F (55°C)
2-port 100-Gigabit Ethernet Line Card	
Power consumption	800 W at 77°F (25°C) 875 W at 104°F (40°C) 920 W at 131°F (55°C)
1-port 100-Gigabit Ethernet Line Card	
Power consumption	460 W at 77°F (25°C) 480 W at 104°F (40°C) 510 W at 131°F (55°C)
80-Gigabyte Modular Line Card	
Power consumption	350 W at 77°F (25°C) 400 W at 104°F (40°C) 420 W at 131°F (55°C)

Table A-22 Card and Fan Tray Power Consumption Specifications (continued)

Description	Value
160-Gigabyte Modular Line Card	
Power consumption	520 W at 77°F (25°C) 590 W at 104°F (40°C) 620 W at 131°F (55°C)
Fan Tray Version 1 (ASR 9010)	
Power consumption	200 W at 77°F (25°C) 300 W at 104°F (40°C) 600 W at 131°F (55°C)
Fan Tray Version 2 (ASR 9010)	
Power consumption	240 W at 77°F (25°C) 960 W at 104°F (40°C) 1100 W at 131°F (55°C)
Fan Tray (ASR 9006)	
Power consumption	100 W at 77°F (25°C) 275 W at 104°F (40°C) 375 W at 131°F (55°C)
Fan Tray (ASR 9904)	
Power consumption	100 W at 77°F (25°C) 360 W at 104°F (40°C) 605 W at 131°F (55°C)
Fan Tray (ASR 9922)	
Power consumption	200 W at 77°F (25°C) 870 W at 104°F (40°C) 1000 W at 131°F (55°C)
Fan Tray (ASR 9912)	
Power consumption	290 W at 77°F (25°C) 900 W at 104°F (40°C) 1800 W at 131°F (55°C)