MX960 Ethernet Services Router
DC Power Supply
Installation Instructions

This document describes how to remove and replace a DC power supply on a Juniper Networks MX960 Ethernet Services Router.

Contents

DC Power Supply

In the DC power configuration, the router contains either two or four DC power supplies (see Figure 1 on page 2), located at the lower rear of the chassis in slots PEM0 through PEM3 (left to right). You can upgrade your DC power system from two to four power supplies. The DC power supplies in slots PEM0 and PEM2 provide power to the lower fan tray, DPC slots 6 through 11, and SCB slots 1 and 2. The DC power supplies in slots PEM1 and PEM3 provide power to the upper fan tray, DPC slots 0 through 5, and SCB slot 0.

Four power supplies provide full redundancy. If a DC power supply fails, its redundant power supply takes over without interruption.

Each DC power supply has a single DC input (–48 VDC and return) that requires a dedicated 80 A (–48 VDC) circuit breaker for the maximum router hardware configuration. For information about site power preparations and connecting the router to power and ground, see the *MX960 Ethernet Services Router Hardware Guide*.

For DC power supply and power system electrical specifications, see Table 1 on page 3 and the *MX960 Ethernet Services Router Hardware Guide*.

Figure 1: DC Power Supply
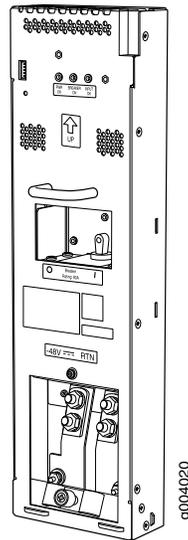
DC Power Supply Electrical Specifications

Table 1 on page 3 lists the DC power supply electrical specifications. For DC power system electrical specifications, see the *MX960 Ethernet Services Router Hardware Guide*.

Table 1: DC Power Supply Electrical Specifications

Item	Specification
Maximum output power	2800 W
DC input voltage	Minimum: –40 VDC
	Nominal: –48 VDC
	Operating range: –40 to –72 VDC
	NOTE: If the input voltage from the DC power source drops below -37.5 to -39.5 VDC, the routing platform automatically shuts down. During automatic shutdown, the circuit remains active. When the input voltage returns to –43.0 to –44.00 VDC, the router automatically starts up again and the system returns to normal operation within 30 minutes. No operator intervention is required.
DC input current rating	70 A maximum @ –48 VDC (nominal operating voltage)
Internal Supplementary Protector	80 A

DC Power Supply LEDs

Each DC power supply faceplate contains three LEDs that indicate the status of the power supply (see Table 2 on page 3). The power supply status is also reflected in two LEDs on the craft interface (see the *MX960 Ethernet Services Router Hardware Guide*). In addition, a power supply failure triggers the red alarm LED on the craft interface.

Table 2: DC Power Supply LEDs

Label	Color	State	Description
PWR OK	Green	Off	Power supply is not functioning normally. Check the INPUT OK LED for more information.
		On	Power supply is functioning normally.
BREAKER ON	Green	Off	DC power supply circuit breaker is turned off.
		On	DC power supply circuit breaker is turned on.
INPUT OK	Green	Off	DC input to the PEM is not present.
		On	DC input is present, and is connected in correct polarity.
	Amber	On	DC input is present, but connected in reverse polarity.

Replacing a DC Power Supply

To replace a DC power supply, use the following procedures:

- Removing a DC Power Supply on page 4

- Installing a DC Power Supply on page 7

Removing a DC Power Supply

The power supplies are located at the rear of the chassis. Each DC power supply weighs approximately 3.8 lb (1.7 kg).

⚠ **CAUTION:** Do not leave a power supply slot empty for more than 30 minutes while the router is operational. For proper airflow, the power supply must remain in the chassis or a blank panel must be used in an empty slot.

☞ **NOTE:** After powering off a power supply, wait at least 60 seconds before turning it back on.

To remove a DC power supply, follow this procedure:

1. Make sure that the voltage across the DC power source cable leads is 0 V and that there is no chance that the cables might become active during the removal process.

2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis. For more information about ESD, see the *MX960 Ethernet Services Router Hardware Guide*.

3. Switch the circuit breaker on the power supply faceplate to the **OFF** position.

4. Remove the clear plastic cover protecting the terminal studs on the faceplate.

5. Remove the nuts and washers from the terminal studs (see Figure 2 on page 5). (Use a 3/8–in. nut driver or pliers.)

Figure 2: Disconnecting Power Cables From the DC Power Supply
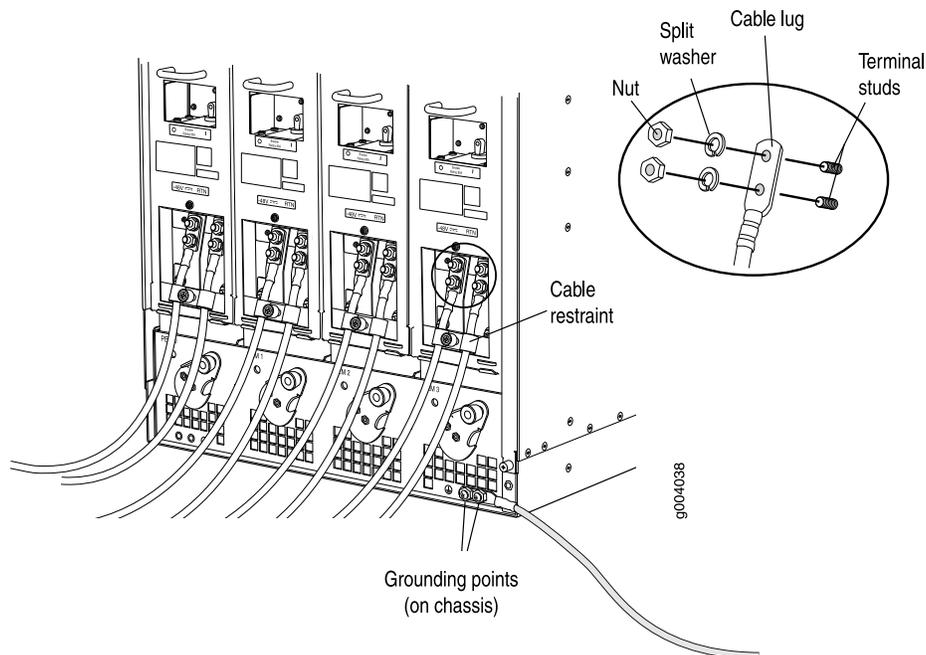
6. Remove the cable lugs from the terminal studs.

7. Loosen the captive screw on the cable restraint on the lower edge of the power supply faceplate.

8. Carefully move the power cables out of the way.

9. While grasping the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops (see Figure 3 on page 6).

10. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

11. Pull the power supply straight out of the chassis.

WARNING: Do not touch the power connector on the top of the power supply (see Figure 4 on page 6). It can contain dangerous voltages.
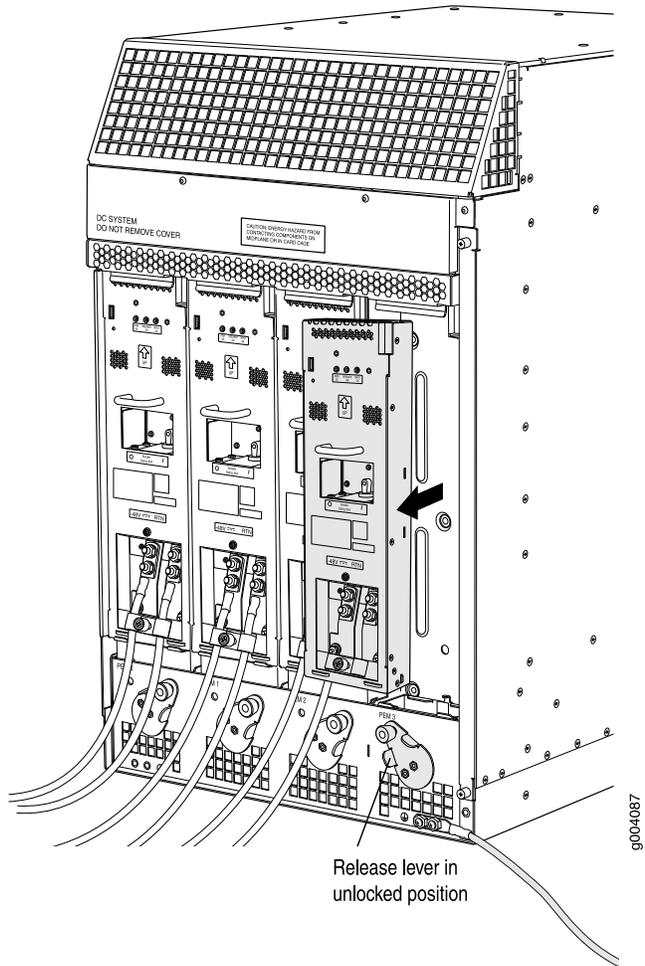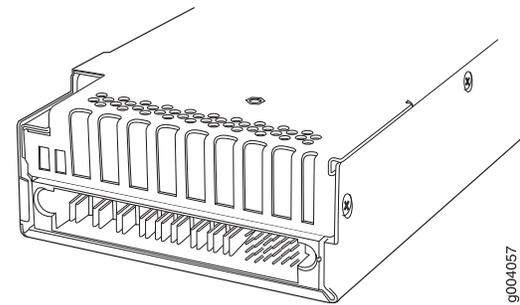
Figure 3: Removing a DC Power Supply

Release lever in
unlocked position

Figure 4: Top of the Power Supply Showing Midplane Connector

Connector end of AC or DC Power supply

Installing a DC Power Supply

To install a DC power supply, follow this procedure (see Figure 5 on page 9):

1. Ensure that the voltage across the DC power source cable leads is 0 V and that there is no chance that the cable leads might become active during installation.

⚠️ **CAUTION:** You must ensure that power connections maintain the proper polarity. The power source cables might be labeled (+) and (–) to indicate their polarity. There is no standard color coding for DC power cables. The color coding used by the external DC power source at your site determines the color coding for the leads on the power cables that attach to the terminal studs on each power supply.

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2. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis. For more information about ESD, see the *MX960 Ethernet Services Router Hardware Guide*.

3. Switch the circuit breaker on the power supply faceplate to the **OFF** position.

4. Ensure that the release lever below the empty power supply slot is engaged in the counterclockwise, or unlocked, position (see Figure 5 on page 9).

   If necessary, pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever counterclockwise until it stops. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

5. Using both hands, slide the power supply straight into the chassis until the power supply is fully seated in the chassis slot. The power supply faceplate should be flush with any adjacent power supply faceplates.

   The small tab on the metal housing that is controlled by the release lever must be inside the corresponding slot at the bottom of the power supply (see Figure 5 on page 9). This tab is used to pull the power supply down in the chassis slot, before the power supply is removed.

6. While firmly pushing the handle on the power supply faceplate with one hand, use your other hand to pull the spring-loaded locking pin in the release lever away from the chassis and turn the release lever clockwise until it stops.

7. Let go of the locking pin in the release lever. Ensure that the pin is seated inside the corresponding hole in the chassis.

8. Remove the clear plastic cover protecting the terminal studs on the faceplate.

9. Remove the nuts and washers from the terminal studs.

10. Attach the lugs on the DC source power cables to the terminal studs, making sure the cables are not touching or in the way of any router components (see Figure 6 on page 10).
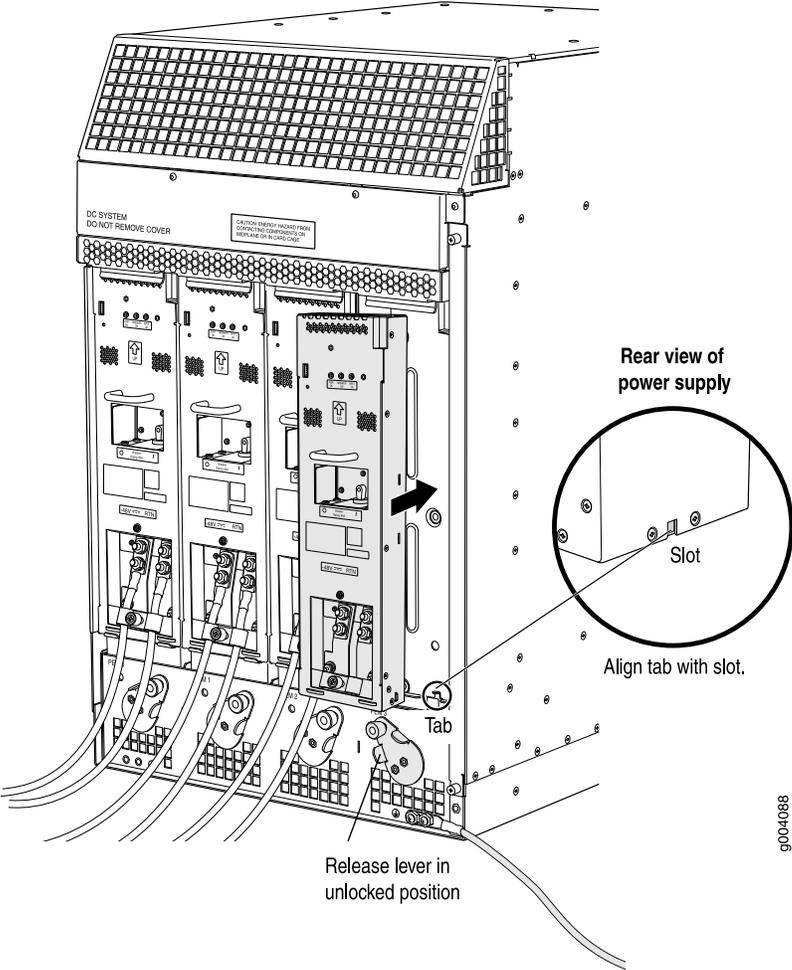
■ Attach the positive (+) DC source power cable lug to the **RTN** (return) terminal.

■ Attach the negative (–) DC source power cable lug to the **–48V** (input) terminal.

☞ **NOTE:** The DC power supplies in slots **PEM0** and **PEM1** must be powered by dedicated power feeds derived from feed **A**, and the DC power supplies in slots **PEM2** and **PEM3** must be powered by dedicated power feeds derived from feed **B**. This configuration provides the commonly deployed **A/B** feed redundancy for the system. For information about connecting to DC power sources, see the *MX960 Ethernet Services Router Hardware Guide*.
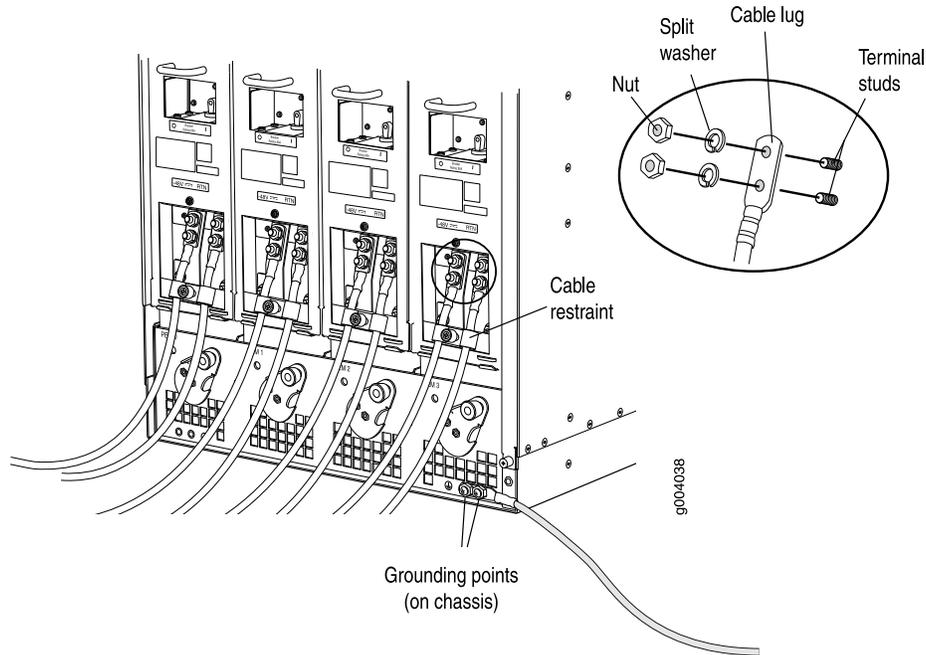
11. Secure each power cable lug to the terminal studs, first with the split washer, then with the nut. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut.

12. Loosen the captive screw on the cable restraint on the lower edge of the power supply faceplate.

13. Route the positive and negative DC power cables through the left and right sides of the cable restraint.

14. Tighten the cable restraint captive screw to hold the power cables in place.

15. Replace the clear plastic cover over the terminal studs on the faceplate.

16. Verify that the ground and power cabling are correct, that they are not touching or blocking access to router components, and that they do not drape where people could trip on them.

17. Switch the circuit breaker on the power supply to the **ON** position and observe the status LEDs on the power supply faceplate. If the power supply is correctly installed and functioning normally, the **PWR OK**, **BREAKER ON**, and **INPUT OK** LEDs light steadily.

Figure 5: Installing a DC Power Supply

DC SYSTEM
DO NOT REMOVE COVER

CAUTION: ENERGY HAZARD FROM
CONTACTING COMPONENTS ON
MIDPLANE OR IN CARD CAGE

**Rear view of
power supply**

Slot

Align tab with slot.

Tab

Release lever in
unlocked position

g004088

Figure 6: Connecting DC Power to the Router

List of Technical Publications

Table 3 on page 10 lists the software and hardware guides and release notes for Juniper Networks J-series, M-series, MX-series, and T-series routing platforms and describes the contents of each document. Table 4 on page 15 lists the books included in the *Network Operations Guide* series.

Table 5 on page 15 lists additional books on Juniper Networks solutions that you can order through your bookstore. A complete list of such books is available at http://www.juniper.net/books.

Table 3: Technical Documentation for Supported Routing Platforms

Book	Description
JUNOS Software for Supported Routing Platforms	
Access Privilege	Explains how to configure access privileges in user classes by using permission flags and regular expressions. Lists the permission flags along with their associated command-line interface (CLI) operational mode commands and configuration statements.
Class of Service	Provides an overview of the class-of-service (CoS) functions of the JUNOS software and describes how to configure CoS features, including configuring multiple forwarding classes for transmitting packets, defining which packets are placed into each output queue, scheduling the transmission service level for each queue, and managing congestion through the random early detection (RED) algorithm.

Table 3: Technical Documentation for Supported Routing Platforms *(continued)*

Book	Description
CLI User Guide	Describes how to use the JUNOS command-line interface (CLI) to configure, monitor, and manage Juniper Networks routing platforms. This material was formerly covered in the *JUNOS System Basics Configuration Guide*.
Feature Guide	Provides a detailed explanation and configuration examples for several of the most complex features in the JUNOS software.
High Availability	Provides an overview of hardware and software resources that ensure a high level of continuous routing platform operation and describes how to configure high availability (HA) features such as nonstop routing (NSR) and graceful Routing Engine switchover (GRES).
MPLS Applications	Provides an overview of traffic engineering concepts and describes how to configure traffic engineering protocols.
Multicast Protocols	Provides an overview of multicast concepts and describes how to configure multicast routing protocols.
Multiplay Solutions	Describes how you can deploy IPTV and voice over IP (VoIP) services in your network.
Network Interfaces	Provides an overview of the network interface functions of the JUNOS software and describes how to configure the network interfaces on the routing platform.
Network Management	Provides an overview of network management concepts and describes how to configure various network management features, such as SNMP and accounting options.
Policy Framework	Provides an overview of policy concepts and describes how to configure routing policy, firewall filters, and forwarding options.
Routing Protocols	Provides an overview of routing concepts and describes how to configure routing, routing instances, and unicast routing protocols.
Secure Configuration Guide for Common Criteria and JUNOS-FIPS	Provides an overview of secure Common Criteria and JUNOS-FIPS protocols for the JUNOS software and describes how to install and configure secure Common Criteria and JUNOS-FIPS on a routing platform.
Services Interfaces	Provides an overview of the services interfaces functions of the JUNOS software and describes how to configure the services interfaces on the router.
Software Installation and Upgrade Guide	Describes the JUNOS software components and packaging and explains how to initially configure, reinstall, and upgrade the JUNOS system software. This material was formerly covered in the *JUNOS System Basics Configuration Guide*.
System Basics	Describes Juniper Networks routing platforms and explains how to configure basic system parameters, supported protocols and software processes, authentication, and a variety of utilities for managing your router on the network.

Table 3: Technical Documentation for Supported Routing Platforms *(continued)*

Book	Description
VPNs	Provides an overview and describes how to configure Layer 2 and Layer 3 virtual private networks (VPNs), virtual private LAN service (VPLS), and Layer 2 circuits. Provides configuration examples.
JUNOS References	
Hierarchy and RFC Reference	Describes the JUNOS configuration mode commands. Provides a hierarchy reference that displays each level of a configuration hierarchy, and includes all possible configuration statements that can be used at that level. This material was formerly covered in the *JUNOS System Basics Configuration Guide*.
Interfaces Command Reference	Describes the JUNOS software operational mode commands you use to monitor and troubleshoot interfaces.
Routing Protocols and Policies Command Reference	Describes the JUNOS software operational mode commands you use to monitor and troubleshoot routing policies and protocols, including firewall filters.
System Basics and Services Command Reference	Describes the JUNOS software operational mode commands you use to monitor and troubleshoot system basics, including commands for real-time monitoring and route (or path) tracing, system software management, and chassis management. Also describes commands for monitoring and troubleshooting services such as class of service (CoS), IP Security (IPSec), stateful firewalls, flow collection, and flow monitoring.
System Log Messages Reference	Describes how to access and interpret system log messages generated by JUNOS software modules and provides a reference page for each message.
J-Web User Guide	
J-Web Interface User Guide	Describes how to use the J-Web graphical user interface (GUI) to configure, monitor, and manage Juniper Networks routing platforms.
JUNOS API and Scripting Documentation	
JUNOScript API Guide	Describes how to use the JUNOScript application programming interface (API) to monitor and configure Juniper Networks routing platforms.
JUNOS XML API Configuration Reference	Provides reference pages for the configuration tag elements in the JUNOS XML API.
JUNOS XML API Operational Reference	Provides reference pages for the operational tag elements in the JUNOS XML API.
NETCONF API Guide	Describes how to use the NETCONF API to monitor and configure Juniper Networks routing platforms.

Table 3: Technical Documentation for Supported Routing Platforms *(continued)*

Book	Description
JUNOS Configuration and Diagnostic Automation Guide	Describes how to use the commit script and self-diagnosis features of the JUNOS software. This guide explains how to enforce custom configuration rules defined in scripts, how to use commit script macros to provide simplified aliases for frequently used configuration statements, and how to configure diagnostic event policies.
JUNOS Enhanced Services Documentation	
Getting Started Guide	Provides an overview, basic instructions, and specifications for J-series Services Routers. The guide explains how to prepare your site for installation, unpack and install the router and its components, install licenses, and establish basic connectivity. Use the Getting Started Guide for JUNOS Enhanced Services.
Interfaces and Routing Guide	Explains how to configure the interfaces on J-series Services Routers running JUNOS Enhanced Services for basic IP routing with standard routing protocols, ISDN backup, digital subscriber line (DSL) connections, and class-of-service (CoS) classification for safer, more efficient routing.
Security Configuration Guide	Explains how to configure J-series Services Routers running JUNOS Enhanced Services in virtual private networks (VPNs) and multicast networks; configure firewall NAT and ALGs; apply routing techniques such as zones, policies, stateful firewall filters, and IP Security (IPSec) tunnels; and configure screens and firewall authentication
Administration Guide	Shows how to manage users and operations, monitor network performance, upgrade software, change routing and secure contexts, and diagnose common problems on J-series Services Routers running JUNOS Enhanced Services.
Design and Implementation Guide	Provides guidelines and examples for designing and implementing IP Security (IPSec) VPNs, firewalls, and routing on J-series routers running JUNOS software with Enhanced Services.
Migration Guide	Provides instructions for migrating an SSG 300M-series or SSG 500M-series security device running ScreenOS software or a J-series router running JUNOS software to JUNOS Enhanced Services.
Hardware Documentation	
Hardware Guide	Describes how to install, maintain, and troubleshoot routing platforms and components. Each platform has its own hardware guide.
PIC Guide	Describes the routing platform's Physical Interface Cards (PICs). Each platform has its own PIC guide.
DPC Guide	Describes the Dense Port Concentrators (DPCs) for all MX-series routers.
JUNOScope Documentation	

Table 3: Technical Documentation for Supported Routing Platforms *(continued)*

Book	Description
JUNOScope Software User Guide	Describes the JUNOScope software graphical user interface (GUI), how to install and administer the software, and how to use the software to manage routing platform configuration files and monitor routing platform operations.
Advanced Insight Solutions (AIS) Documentation	
AIS Operations Guide	
J-series Routing Platform Documentation	
Getting Started Guide	Provides an overview, basic instructions, and specifications for J-series routing platforms. The guide explains how to prepare your site for installation, unpack and install the router and its components, install licenses, and establish basic connectivity. Use the Getting Started Guide for your router model.
Basic LAN and WAN Access Configuration Guide	Explains how to configure the interfaces on J-series Services Routers for basic IP routing with standard routing protocols, ISDN backup, and digital subscriber line (DSL) connections.
Advanced WAN Access Configuration Guide	Explains how to configure J-series Services Routers in virtual private networks (VPNs) and multicast networks, configure data link switching (DLSw) services, and apply routing techniques such as policies, stateless and stateful firewall filters, IP Security (IPSec) tunnels, and class-of-service (CoS) classification for safer, more efficient routing.
Administration Guide	Shows how to manage users and operations, monitor network performance, upgrade software, and diagnose common problems on J-series Services Routers.
Release Notes	
JUNOS Release Notes	Summarize new features and known problems for a particular software release, provide corrections and updates to published JUNOS, JUNOScript, and NETCONF manuals, provide information that might have been omitted from the manuals, and describe upgrade and downgrade procedures.
Hardware Release Notes	Describe the available documentation for the routing platform and summarize known problems with the hardware and accompanying software. Each platform has its own release notes.
JUNOScope Release Notes	Contain corrections and updates to the published JUNOScope manual, provide information that might have been omitted from the manual, and describe upgrade and downgrade procedures.
AIS Operations Release Notes	
AIS ai-script Release Notes	
J-series Services Router Release Notes	Briefly describe Services Router features, identify known hardware problems, and provide upgrade and downgrade instructions.

Table 3: Technical Documentation for Supported Routing Platforms *(continued)*

Book	Description
JUNOS Enhanced Services Release Notes	Summarize new features for a particular release, identify known hardware and software problems, provide information that might have been omitted from the manuals, and provide upgrade and downgrade instructions.

Table 4: JUNOS Software Network Operations Guides

Book	Description
Baseline	Describes the most basic tasks for running a network using Juniper Networks products. Tasks include upgrading and reinstalling JUNOS software, gathering basic system management information, verifying your network topology, and searching log messages.
Interfaces	Describes tasks for monitoring interfaces. Tasks include using loopback testing and locating alarms.
MPLS	Describes tasks for configuring, monitoring, and troubleshooting an example MPLS network. Tasks include verifying the correct configuration of the MPLS and RSVP protocols, displaying the status and statistics of MPLS running on all routing platforms in the network, and using the layered MPLS troubleshooting model to investigate problems with an MPLS network.
MPLS Log Reference	Describes MPLS status and error messages that appear in the output of the **show mpls lsp extensive** command. The guide also describes how and when to configure Constrained Shortest Path First (CSPF) and RSVP trace options, and how to examine a CSPF or RSVP failure in a sample network.
MPLS Fast Reroute	Describes operational information helpful in monitoring and troubleshooting an MPLS network configured with fast reroute (FRR) and load balancing.
Hardware	Describes tasks for monitoring M-series and T-series routing platforms.

Table 5: Additional Books Available Through http://www.juniper.net/books

Book	Description
Interdomain Multicast Routing	Provides background and in-depth analysis of multicast routing using Protocol Independent Multicast sparse mode (PIM SM) and Multicast Source Discovery Protocol (MSDP); details any-source and source-specific multicast delivery models; explores multiprotocol BGP (MBGP) and multicast IS-IS; explains Internet Gateway Management Protocol (IGMP) versions 1, 2, and 3; lists packet formats for IGMP, PIM, and MSDP; and provides a complete glossary of multicast terms.
JUNOS Cookbook	Provides detailed examples of common JUNOS software configuration tasks, such as basic router configuration and file management, security and access control, logging, routing policy, firewalls, routing protocols, MPLS, and VPNs.

Table 5: Additional Books Available Through http://www.juniper.net/books *(continued)*

Book	Description
MPLS-Enabled Applications	Provides an overview of Multiprotocol Label Switching (MPLS) applications (such as Layer 3 virtual private networks [VPNs], Layer 2 VPNs, virtual private LAN service [VPLS], and pseudowires), explains how to apply MPLS, examines the scaling requirements of equipment at different points in the network, and covers the following topics: point-to-multipoint label switched paths (LSPs), DiffServ-aware traffic engineering, class of service, interdomain traffic engineering, path computation, route target filtering, multicast support for Layer 3 VPNs, and management and troubleshooting of MPLS networks.
OSPF and IS-IS: Choosing an IGP for Large-Scale Networks	Explores the full range of characteristics and capabilities for the two major link-state routing protocols: Open Shortest Path First (OSPF) and IS-IS. Explains architecture, packet types, and addressing; demonstrates how to improve scalability; shows how to design large-scale networks for maximum security and reliability; details protocol extensions for MPLS-based traffic engineering, IPv6, and multitopology routing; and covers troubleshooting for OSPF and IS-IS networks.
Routing Policy and Protocols for Multivendor IP Networks	Provides a brief history of the Internet, explains IP addressing and routing (Routing Information Protocol [RIP], OSPF, IS-IS, and Border Gateway Protocol [BGP]), explores ISP peering and routing policies, and displays configurations for both Juniper Networks and other vendors' routers.
The Complete IS-IS Protocol	Provides the insight and practical solutions necessary to understand the IS-IS protocol and how it works by using a multivendor, real-world approach.

Requesting Support

For technical support, open a support case with the Case Manager link at http://www.juniper.net/support/ or call 1-888-314-JTAC (from the United States, Canada, or Mexico) or 1-408-745-9500 (from elsewhere).

Revision History

19 October 2007—530-017577-01 Revision 2. Corrected the DPC slot range supported by power supplies **PEM0** and **PEM2**.

12 March 2007—530-017577-01 Revision 1.