T1600 Internet Routing Node Upgrade Guide

This guide provides procedures for upgrading an operational T640 Internet routing node to a T1600 Internet routing node. These procedures include preparing the site, replacing hardware, and verifying operation.

☞ **NOTE:** Before you upgrade, the T640 routing node must be running JUNOS Release 8.5 or later.

Contents

■ 1

T1600 Routing Node Overview

The T1600 Internet routing node is a complete routing system that provides Gigabit Ethernet, SONET/SDH, and other high-speed interfaces for large networks and network applications, such as those supported by Internet service providers (ISPs). The routing node accommodates up to eight Flexible PIC Concentrators (FPCs), which can each be configured with a variety of network media types. The T1600 routing node provides up to 800 gigabits per second (Gbps), full duplex (1600 Gbps of any-to-any, non-blocking, half-duplex switching).

The routing node architecture cleanly separates control operations from packet forwarding operations. This design eliminates processing and traffic bottlenecks, permitting the routing node to achieve high performance.

■   Control operations in the routing node are performed by the host subsystem, which runs JUNOS Internet software to handle routing protocols, traffic engineering, policy, policing, monitoring, and configuration management.

■   Forwarding operations in the routing node are performed by the Packet Forwarding Engines, which consist of hardware, including ASICs, designed by Juniper Networks. Application-specific integrated circuits (ASICs) are a definitive part of the routing node design; these ASICs enable the routing node to achieve data forwarding rates that match current fiber-optic capacity. The T1600 routing node provides up to a total of 1600 million packets per second (Mpps) of forwarding.

Figure 1 on page 4 and Figure 2 on page 5 illustrate the front and rear of a T1600 routing node.

Figure 1: Front View of the T1600 Routing Node

Front-mounting flange

Center-mounting bracket

Craft interface

Fan tray

FPCs

CIP

ESD point

Air filter

Fan tray

Air intake

g002400
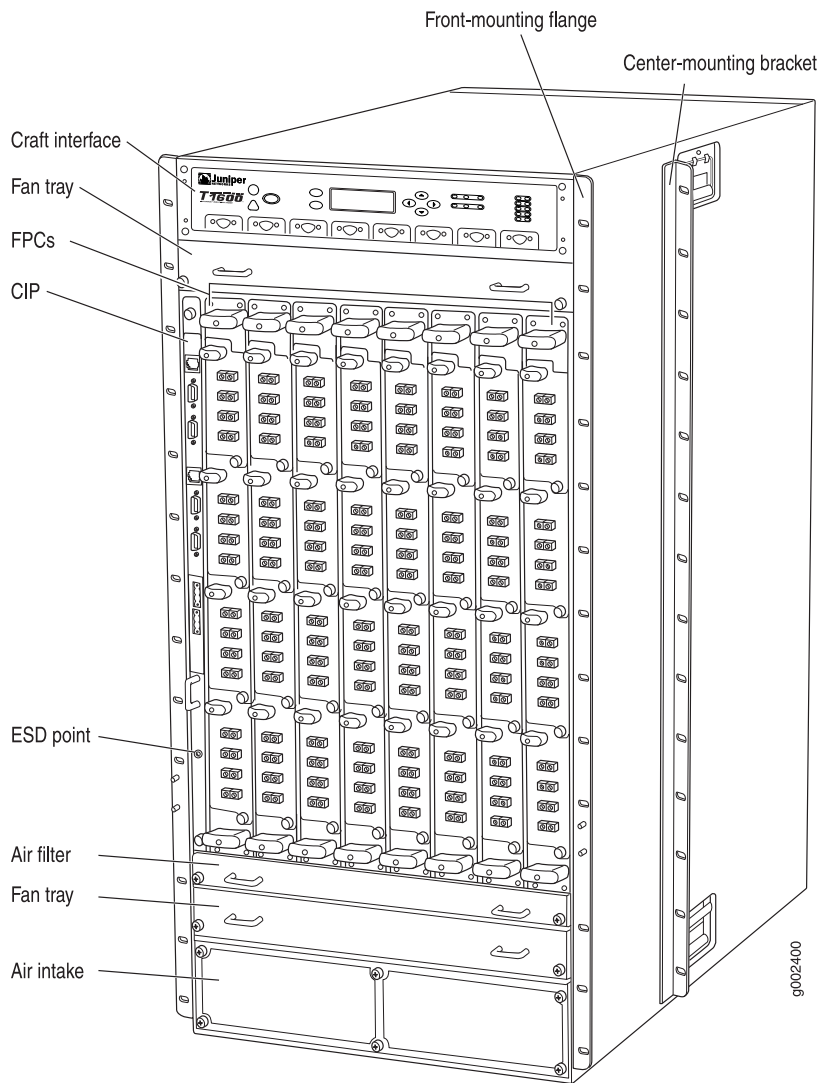
Figure 2: Rear View of the T1600 Routing Node

Fan tray

Air exhaust

SCGs

T-CB0

Routing Engines

T-CB1

T-1600
SIBs

Air filter

3-input 240-A
power supply
PEM 0

3-input 240-A
power supply
PEM 1

ESD point

Grounding points

g002401
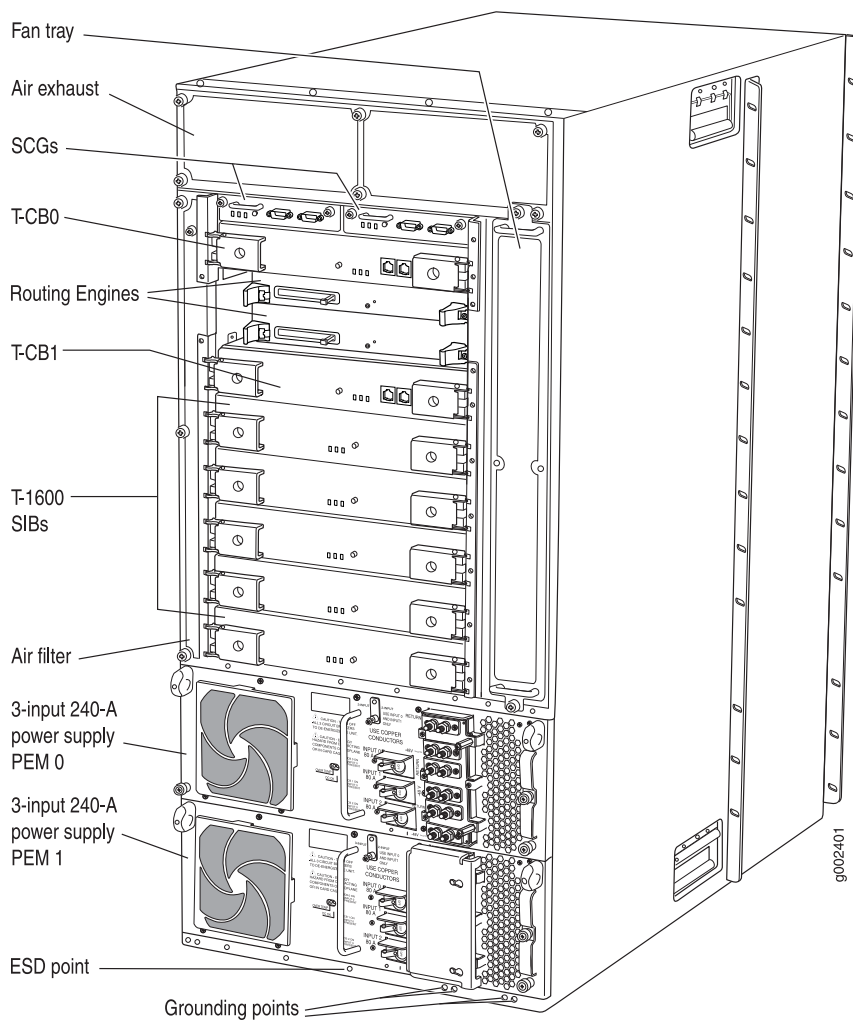
T1600 Upgrade Kit

To upgrade a T640 routing node to a T1600 routing node, you install the following hardware components:

■ Two redundant, load-sharing, three-input 240-A power supplies that connect to the rear of the midplane

■ Five T1600-SIBs

■ One T1600 craft interface panel

You can order these components individually or order a T1600 upgrade kit that contains all the components. You must supply four additional DC power cables.

☞ **NOTE:** These components must be installed before you can install a T1600-FPC in the T1600 routing node.

Power Supplies

Two redundant, load-sharing DC power supplies are located at the lower rear of the chassis in slots PEM0 and PEM1 (top to bottom). For power specifications for the system, power supplies, and power cables, see "T1600 Routing Node DC Power Specifications" on page 44.

Three-Input 240-A Power Supplies

Each three-input 240-A power supply weighs approximately 25 lb. (11.3 kg) and consists of three inputs, three 80-A circuit breakers, a fan, and LEDs to monitor the status of the power supply. Figure 3 on page 6 shows the three-input 240-A power supply.

Figure 3: Three-Input 240-A Power Supply
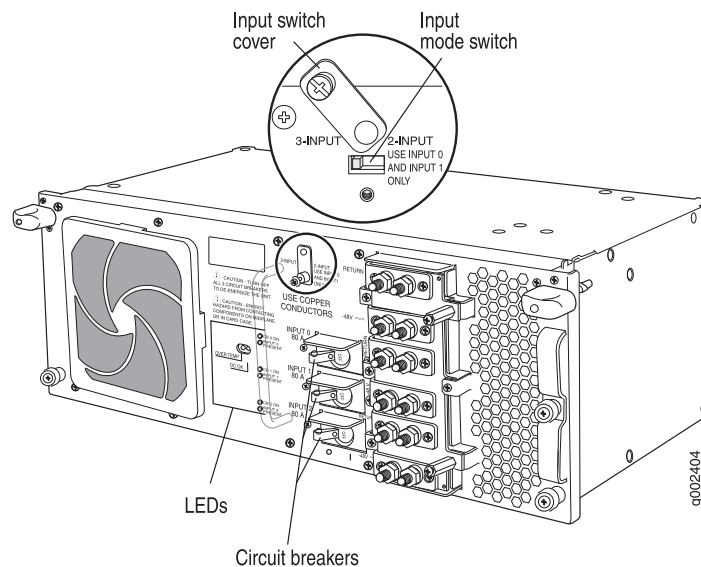
Three-Input 240-A Power Supply Inputs

The three-input 240-A DC power supply inputs are labeled INPUT 0, INPUT 1, and INPUT 2, from top to bottom. Each input consists of –48 VDC and return—each with its own 80-A circuit breaker. The input mode switch on the faceplate allows you to set the DC power supply to either two-input or three-input mode mode. Three-input mode is required for the T1600 routing node. Two-input mode is not currently supported.

Table 1 on page 7 describes which components are powered by each input.

Table 1: Components Powered by Each Three-Input 240-A Power Supply Input

Input	Three-Input Mode	Two-Input Mode
INPUT 0	T1600-SIBs, T-CBs, fan trays, and Routing Engines	FPCs in slots **FPC0** and **FPC1**, SIBs, T-CBs, fan trays, and Routing Engines
INPUT 1	FPCs in slots **FPC4** through **FPC7**	FPCs in slots **FPC2** and **FPC7**
INPUT 2	FPCs in slots **FPC0** through **FPC3**	Not applicable

Three-Input 240-A Power Supply Load Sharing and Fault Tolerance

When the routing node is operating normally and both power supplies are switched on, load sharing between them occurs automatically. When one power supply fails or is turned off, the other power supply immediately assumes the entire electrical load for the system. A single power supply can provide full power for as long as the routing node is operational. Table 2 on page 7 describes the behavior of the power supply if one of the inputs fails.

Table 2: Fault Tolerance

Input	Three-Input Mode	Two-Input Mode
INPUT 0	If this input fails, INPUT 0, INPUT 1, and INPUT 2 shut down. The power supply shuts down, and the other power supply assumes the electrical load for all three inputs.	If this input fails, INPUT 0 and INPUT 1 shut down. The power supply shuts down, and the other power supply assumes the electrical load of INPUT 0 and INPUT 1.
INPUT 1	If this input fails, INPUT 0 is unaffected and INPUT 1 and INPUT 2 shut down. The other power supply assumes the electrical load of INPUT 1 and INPUT 2.	If this input fails, INPUT 0 is unaffected and INPUT 1 shuts down. The other power supply assumes the electrical load of INPUT 1.
INPUT 2	If this input fails, INPUT 0 is unaffected and INPUT 1 and INPUT 2 shut down. The other power supply assumes the electrical load of INPUT 1 and INPUT 2.	Not applicable

Three-Input 240-A Power Supply LEDs

LEDs on each power supply faceplate (see Figure 4 on page 8) indicate the status of the power supply. In addition, a power supply failure triggers the red alarm LED on the craft interface. Table 3 on page 8 describes the functions of the power supply LEDs.

Figure 4: Three-Input 240-A Power Supply LEDs
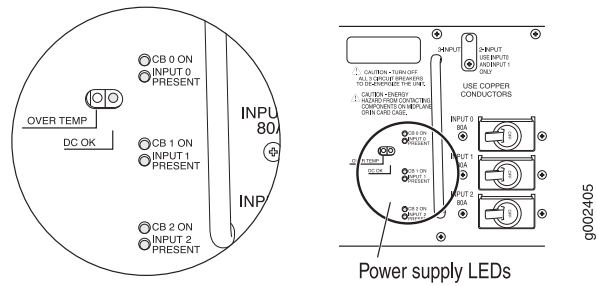
Power supply LEDs

Table 3 on page 8 describes the three-input 240-A power supply LEDs.

Table 3: Three-Input 240-A Power Supply LEDs

LED	Color	State	Description
CB ON—One per input	Green	On steadily	Circuit breaker is on.
		Off	Circuit breaker is not turned on, or host subsystem has detected a failure and has turned the circuit breaker off.
DC OK—One per power supply	Blue	On steadily	When the power supply is correctly set to three-input mode mode and all three inputs are properly energized, the DC OK LED indicates that the power supply is functioning normally. When the power supply is correctly set to two-input mode and INPUT 0 and INPUT 1 are both properly energized, the DC OK LED indicates that the power supply is functioning normally.
		Blinking	Power supply is starting up, is not functioning, is not properly installed, or is not operating properly.
INPUT PRESENT—One per input	Green	On steadily	Input is receiving voltage.
		Off	Input voltage is not present.
OVER TEMP—One per power supply	Amber	On steadily	Power supply has exceeded recommended temperature.
		Off	Power supply is within the recommended temperature or the power supply is not on.

T1600-SIBs

Figure 5 on page 9 shows a T1600-SIB.

Figure 5: T1600-SIB
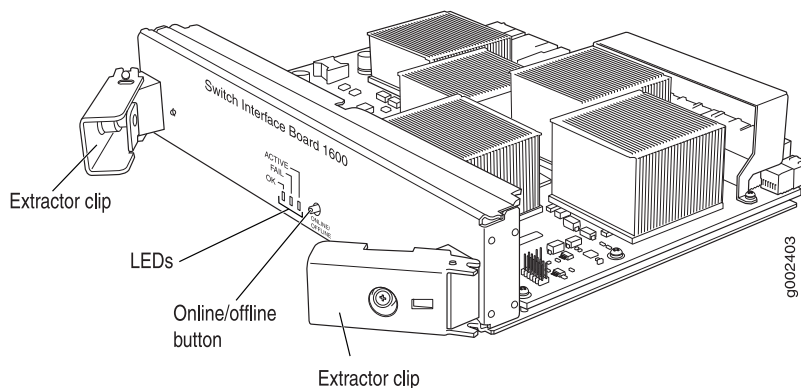
Each T1600-SIB consists of the following components:

■ Switch fabric ASICs.

■ High-speed links to each FPC.

■ SIB online/offline button, located on the SIB faceplate.

■ Three LEDs located on the SIB faceplate that display the status of the SIB. Table 4 on page 9 describes the functions of the SIB LEDs. If all three LEDs are off, the SIB is not receiving power. The craft interface has three additional LEDs that show the status of each T1600-SIB. The OK and FAIL LEDs are replicated on the craft interface.

Table 4: SIB LEDs

Label	Color	State	Description
ACTIVE	Green	On steadily	SIB is in active mode.
OK	Green	On steadily	SIB is functioning normally.
		Blinking	SIB is starting up.
FAIL	Amber	On steadily	SIB has failed.

Each SIB weighs approximately 6.5 lb (3 kg).

T1600 Routing Node Upgrade Overview

👉 **NOTE:** The T640 routing node can be upgraded while the routing node is powered on and operational.

👉 **NOTE:** During the SIB upgrade:

■ The routing node should not experience packet loss if the traffic is less than 50 percent per Packet Forwarding Engine in each FPC.

■ The routing node might experience some packet loss if the traffic is more than 50 percent per Packet Forwarding Engine in each FPC, depending on the operational environment.

For more information, contact your customer support representative.

To upgrade the T640 routing node, use the following procedures:

1. If you have not already done so, install JUNOS Release 8.5 or later in the T640 routing node.

2. Verify that the required hardware version of the rear fan tray is installed. If needed, order a new rear fan tray.

3. Prepare the site. Provision additional power as needed.

4. Remove one two-input 160-A power supply.

5. Install a three-input 240-A power supply.

6. Replace the other power supply.

7. Upgrade the existing standard SIBs to T1600-SIBs.

8. Remove the upper fan tray.

9. Replace the craft interface.

10. Reinstall the upper fan tray.

11. Verify the installation of components.

12. Attach the T1600 agency label.

13. Register your T1600 upgrade.

👉 **NOTE:** Do not install T1600-FPC4s until after all upgrade procedures are completed.

Verifying the Hardware Version of the Rear Fan Tray

The rear fan tray, model number FAN-REAR-TX-T640-S, has eight fans and is required to support the additional thermal power generation of the T1600 routing node. Model number RHTREARTRAY-T-S has five blowers and does not provide sufficient cooling for the T1600 routing node. To verify that FAN-REAR-TX-T640-S is installed:

1. Issue the show chassis environment command:

   In this example, the output shows that the rear fan tray has five blowers, indicating that RHTREARTRAY-T-S is installed. The last five lines of the output for the fans each include Blower in the description.

   ```
   user@host> show chassis environment

   Fans  Top Left Front fan          OK        Spinning at normal speed
         Top Left Middle fan         OK        Spinning at normal speed
         Top Left Rear fan           OK        Spinning at normal speed
         Top Right Front fan         OK        Spinning at normal speed
         Top Right Middle fan        OK        Spinning at normal speed
         Top Right Rear fan          OK        Spinning at normal speed
         Bottom Left Front fan       OK        Spinning at normal speed
         Bottom Left Middle fan      OK        Spinning at normal speed
         Bottom Left Rear fan        OK        Spinning at normal speed
         Bottom Right Front fan      OK        Spinning at normal speed
         Bottom Right Middle fan     OK        Spinning at normal speed
         Bottom Right Rear fan       OK        Spinning at normal speed
         Fourth Blower from top      OK        Spinning at normal speed
         Bottom Blower               OK        Spinning at normal speed
         Middle Blower               OK        Spinning at normal speed
         Top Blower                  OK        Spinning at normal speed
         Second Blower from top      OK        Spinning at normal speed
   ```

   In this example, the output shows that the rear fan tray has eight fans, indicating that FAN-REAR-TX-T640-S is installed. The last eight lines of the output for the fans each begin with Rear Tray and include fan in the description.

   ```
   Fans  Top Left Front fan          OK        Spinning at normal speed

         Top Left Middle fan         OK        Spinning at normal speed

         Top Left Rear fan           OK        Spinning at normal speed

         Top Right Front fan         OK        Spinning at normal speed

         Top Right Middle fan        OK        Spinning at normal speed

         Top Right Rear fan          OK        Spinning at normal speed

         Bottom Left Front fan       OK        Spinning at normal speed

         Bottom Left Middle fan      OK        Spinning at normal speed

         Bottom Left Rear fan        OK        Spinning at normal speed

         Bottom Right Front fan      OK        Spinning at normal speed
   ```

```
                 Bottom Right Middle fan        OK          Spinning at normal speed

                 Bottom Right Rear fan          OK          Spinning at normal speed

                 Rear Tray Top fan              OK          Spinning at normal speed

                 Rear Tray Second fan           OK          Spinning at normal speed

                 Rear Tray Third fan            OK          Spinning at normal speed

                 Rear Tray Fourth fan           OK          Spinning at normal speed

                 Rear Tray Fifth fan            OK          Spinning at normal speed

                 Rear Tray Sixth fan            OK          Spinning at normal speed

                 Rear Tray Seventh fan          OK          Spinning at normal speed

                 Rear Tray Bottom fan           OK          Spinning at normal speed
```

2. If RHTREARTRAY-T-S is installed, order FAN-REAR-TX-T640-S and install it before installing the three-input 240-A power supplies.

Preparing the Site

The following sections describe how to prepare your site so that you can install upgrade components.

- Typical Power Distribution on page 12
- Provisioning Additional Power for the T1600 Routing Node on page 13

Typical Power Distribution

Most sites distribute DC power through a main conduit that leads to frame-mounted DC power distribution panels, one of which might be located at the top of the rack that houses the T1600 routing node. A pair of cables (one input and one return) connects each set of terminal studs to the power distribution panel.

The DC power supply in slot PEM0 must be powered by a dedicated power feed derived from feed A, and the DC power supply in slot PEM1 must be powered by a dedicated power feed derived from feed B. This configuration provides the commonly deployed A/B feed redundancy for the system.

Figure 6 on page 13 shows a typical DC source cabling arrangement.

Figure 6: Typical DC Source Cabling to the T1600 Routing Node
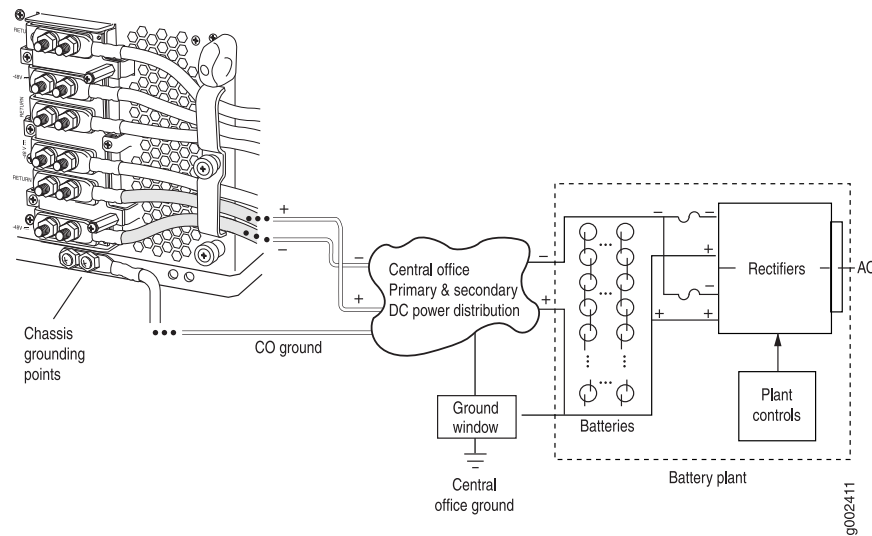
Provisioning Additional Power for the T1600 Routing Node

For a maximally configured T1600 routing node, we recommend that you provision at least 64 A @ –48 VDC for each power supply input in the system.

We recommend that you provision a facility circuit breaker for each DC power supply input rated for at least 125% of the continuous current that the input draws at –48 VDC.

Replacing the Rear Fan Tray

☞ **NOTE:** If the rear fan tray (model number FAN-REAR-TX-T640-S) is already installed, replacing the rear fan tray is not necessary. Proceed to "Upgrading the DC Power Supplies" on page 17.

The rear fan tray is hot-insertable and hot-removable. To replace a fan tray, use the following procedures:

- Removing the Rear Fan Tray on page 14
- Installing a Rear Fan Tray on page 15

Removing the Rear Fan Tray

The rear fan tray is mounted vertically on the right side of the rear of the chassis. The rear fan tray (model number RHTREARTRAY-T-S) weighs about 12 lb (5.4 kg).

To remove the rear fan tray, follow this procedure (see Figure 7 on page 15):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis. See "Preventing Electrostatic Discharge Damage" on page 47.

2. Loosen the captive screws on the top and bottom of the fan tray faceplate, using a Phillips (+) screwdriver, number 2.

3. Grasp the handles and pull the fan tray halfway out of the chassis.

WARNING: To avoid injury, keep tools and your fingers away from the fans as you slide the fan tray out of the chassis. The fans might still be spinning.

---

4. When the fans stop spinning, grasp the handles and pull the fan tray completely out of the chassis.

CAUTION: To maintain proper cooling, do not operate the T1600 routing node with the rear fan tray removed for more than one minute.

Figure 7: Removing the Rear Fan Tray
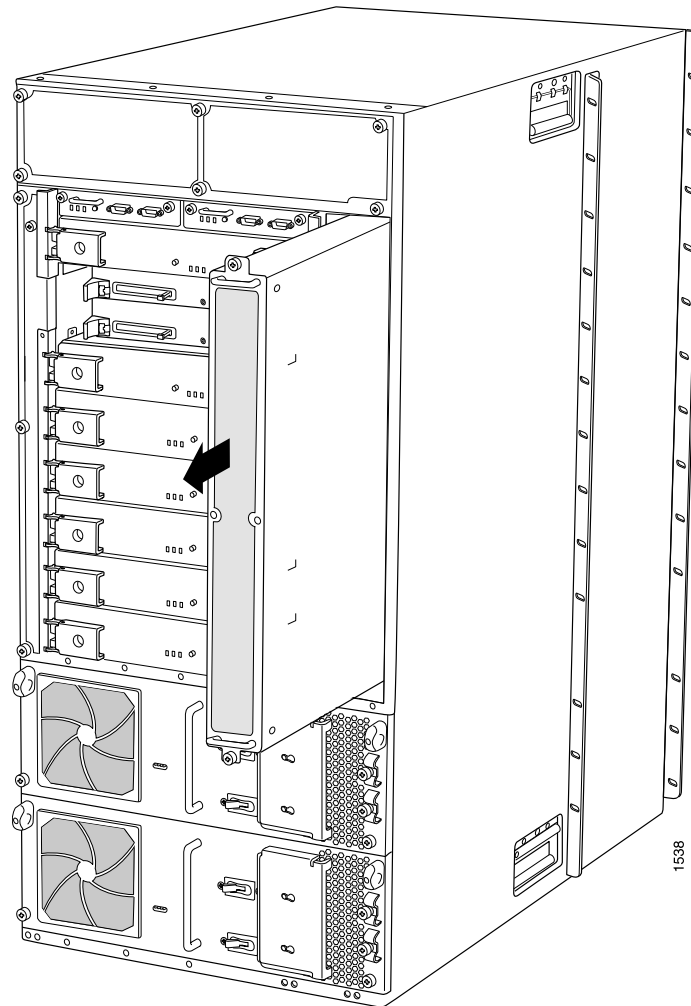
Installing a Rear Fan Tray

The rear fan tray (model number FAN-REAR-TX-T640-S) weighs about 10 pounds (4.5 kg). To install a replacement rear fan tray, follow this procedure (see Figure 8 on page 16):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis. See "Preventing Electrostatic Discharge Damage" on page 47.

2. Grasp the fan tray by its handles and insert it straight into the chassis.

3. Tighten the captive screws on the fan tray faceplate to secure it in the chassis, using a Phillips (+) screwdriver, number 2.

Figure 8: Installing a Rear Fan Tray

1539
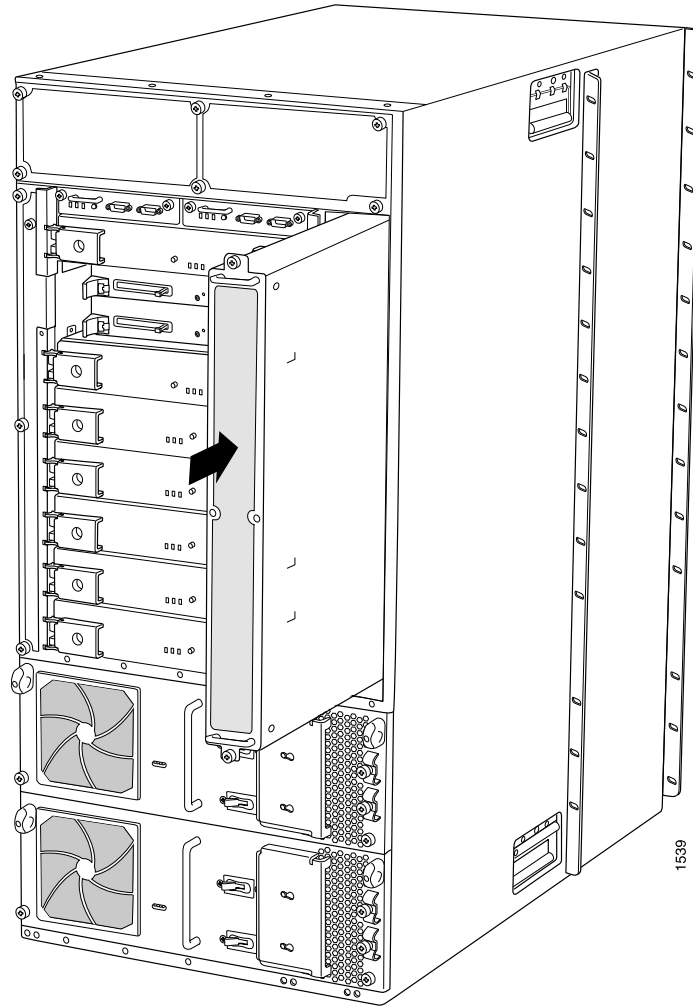
Upgrading the DC Power Supplies

☞ **NOTE:** You must upgrade both power supplies. Follow these procedures for one power supply, then immediately upgrade the other power supply. Mixing a two-input 160-A power supply and a three-input 240-A power supply is supported only during the upgrade.

The power supplies are located at the lower rear of the chassis. Each power supply is hot-insertable and hot-removable. When one power supply is powered down or removed, the other power supply automatically assumes the entire electrical load for the routing node. To upgrade each two-input 160-A power supply to a three-input 240-A power supply, use the following procedures:

- Preparing the DC Power Cables on page 17
- Tools and Parts Required on page 17
- Removing a Two-Input 160-A Power Supply on page 18
- Setting the Input Mode Switch on a Three-Input 240-A Power Supply on page 21
- Installing a Three-Input 240-A Power Supply on page 22
- Replacing the Cable Restraint on a Three-Input 240-A Power Supply on page 23
- Connecting a Three-Input 240-A Power Supply on page 25
- Powering On a Three-Input 240-A Power Supply on page 26

Preparing the DC Power Cables

The accessory box shipped with the installation kit includes the cable lugs that attach to the terminal studs of each power supply (see Figure 25 on page 46).

⚠ **CAUTION:** Before the power supply installation begins, a licensed electrician must attach cable lugs to the power cables that you supply. A cable with an incorrectly attached lug can damage the power supply.

Tools and Parts Required

To upgrade the power supplies, you need the following tools and parts:

- Four additional DC power cables (two cables for each power supply)
- Electrostatic discharge (ESD) grounding wrist strap
- 7/16-in. nut driver or pliers

⚠ **CAUTION:** Do not substitute a metric nut driver or wrench. A tool that does not fit the nuts exactly can damage them. If a 7/16-in. tool is not available, use pliers or an adjustable wrench.

- Phillips (+) screwdrivers, numbers 1 and 2
- Flashlight
- Non-conductive sharp object to set the input-mode switch
- Wire cutters

Removing a Two-Input 160-A Power Supply

To remove a two-input 160-A power supply, follow this procedure:

1. Switch off the external circuit breakers to the power supply being removed. 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. See "Preventing Electrostatic Discharge Damage" on page 47.

3. Switch both circuit breakers on the power supply faceplate to the off position (O).

Figure 9: Two-Input 160-A Power Supply

LEDs

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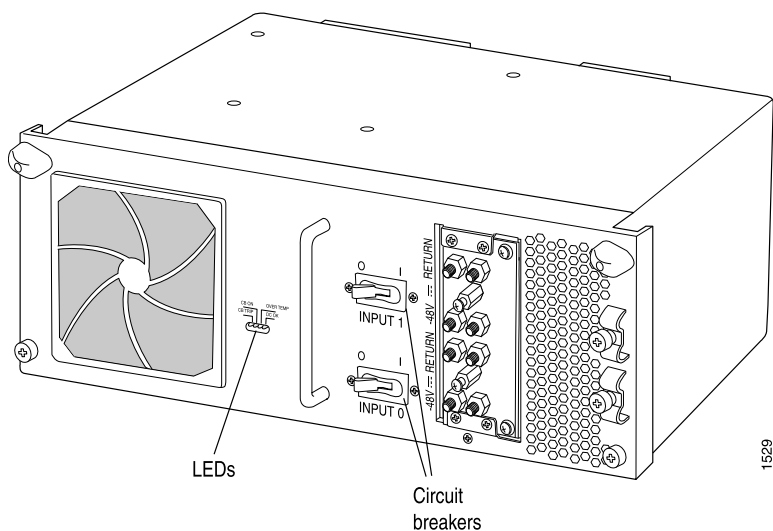
☞ **NOTE:** After powering off a power supply, wait at least 60 seconds before turning it back on.

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

> ⚠ **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.

5. Using a 7/16-in. nut driver or pliers, remove the nuts and washers from the terminal studs (see Figure 10 on page 19).

Figure 10: Disconnecting Power Cables From the DC Power Supply
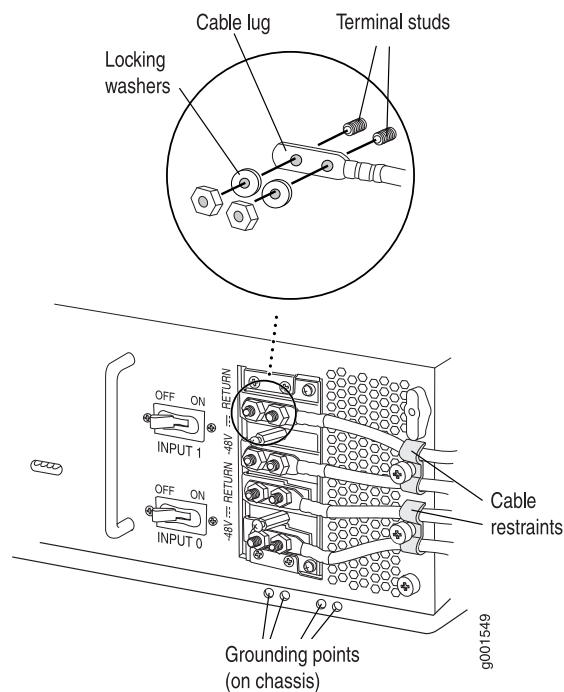
6. Remove the cable lugs from the terminal studs.

7. Loosen the captive screws on the cable restraints on the right edge of the power supply faceplate.

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

9. Loosen the captive screws on the lower corners of the power supply faceplate completely.

10. Twist the ejector handles on the upper corners of the faceplate counterclockwise to unseat the power supply.

> ⚡ **WARNING:** Do not touch the power connectors on the rear of the power supply (see Figure 11 on page 20). They can contain dangerous voltages.

Figure 11: Rear of the Power Supply Showing Midplane Connectors

1530
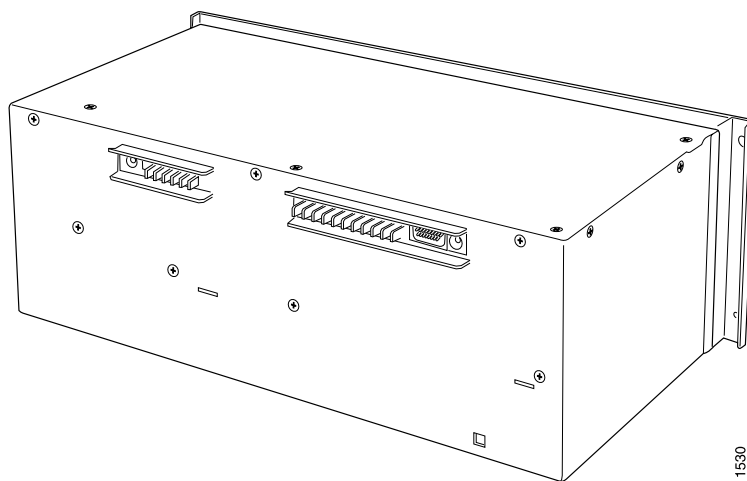
11. Grasp the handle on the power supply faceplate and pull firmly. Slide it halfway out of the chassis (see Figure 12 on page 21).

⚠ **CAUTION:** Each two-input 160-A power supply weighs approximately 23 lb (10.5 kg). Be prepared to support the full weight of the power supply as you remove it from the routing platform.

12. Place one hand underneath the power supply to support it and slide it completely out of the chassis.

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

Figure 12: Removing a Power Supply
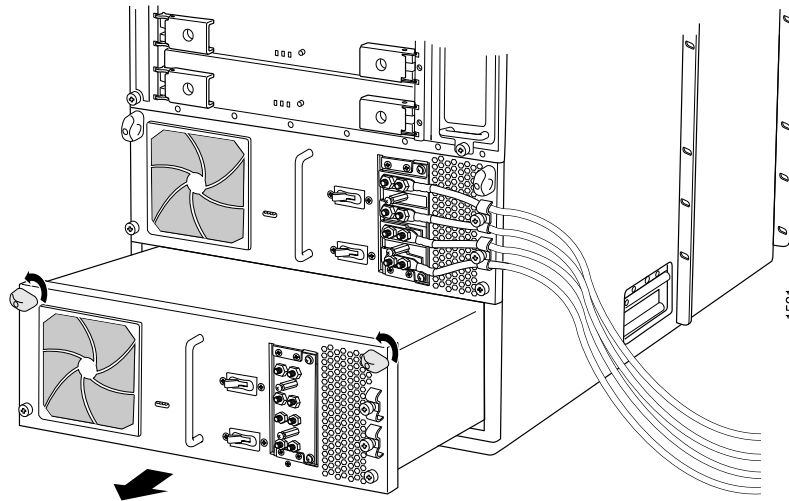
Setting the Input Mode Switch on a Three-Input 240-A Power Supply

☞ **NOTE:** Do not set the input mode switch if the power supply is installed in the chassis. If the power supply is already installed, you must remove it before setting the input mode switch.

To set the input mode switch:

1. Using a screwdriver, loosen the captive screw holding the metal cover over the input mode switch (see Figure 13 on page 22).

2. Rotate the metal cover away from the input mode switch to expose the switch.

3. Check the setting of the input mode switch. Use a flashlight, if necessary. In 3-INPUT mode, the switch is located all the way to the left.

4. Use a sharp, nonconductive object to slide the switch all the way to the left to set the power supply to three-input mode.

⚠ **CAUTION:** Do not use a pencil, because fragments can break off and cause damage to the power supply.

5. Rotate the metal cover over the input mode switch, and use a screwdriver to tighten the captive screw.

Figure 13 on page 22 shows the input mode switch.

Figure 13: Three-Input 240-A Power Supply
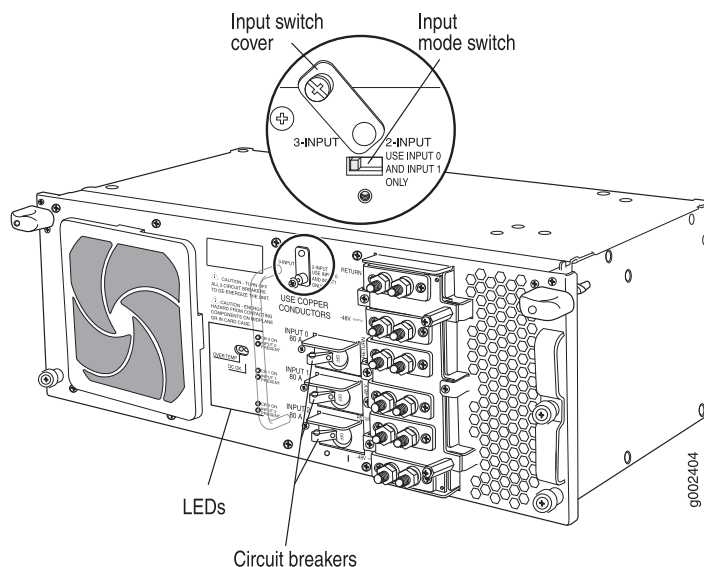
Installing a Three-Input 240-A Power Supply

Each three-input 240-A power supply weighs approximately 25 lb (11.3 kg). To install a three-input 240-A 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 installation.

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. See "Preventing Electrostatic Discharge Damage" on page 47.

3. Switch the circuit breakers on the power supply faceplate to the OFF position (O).

4. Using both hands, slide the power supply into the chassis until you feel resistance (see Figure 14 on page 23).

5. Twist the ejector handles at the upper corners of the power supply faceplate clockwise until they stop.

6. Tighten the captive screws at the lower corners of the power supply faceplate to secure the power supply in the chassis.

Figure 14: Installing a Three-Input 240-A Power Supply
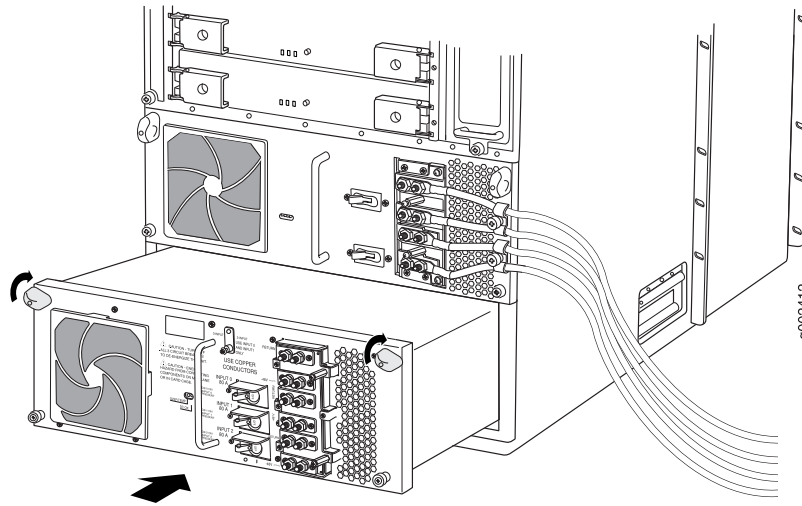
Replacing the Cable Restraint on a Three-Input 240-A Power Supply

Each three-input 240-A power supply is shipped with the standard cable restraint shown in Figure 15 on page 23. Two optional cable restraints are shipped in the accessory box for the T1600 routing node and in the T1600 upgrade kit.

If your DC power cables are too large or inflexible to fit into the standard cable restraint, we recommend that you remove the standard cable restraint and install the optional cable restraint (see Figure 16 on page 24) on each three-input 240-A power supply.

Figure 15: Three-Input 240-A Power Supply with the Standard Cable Restraint
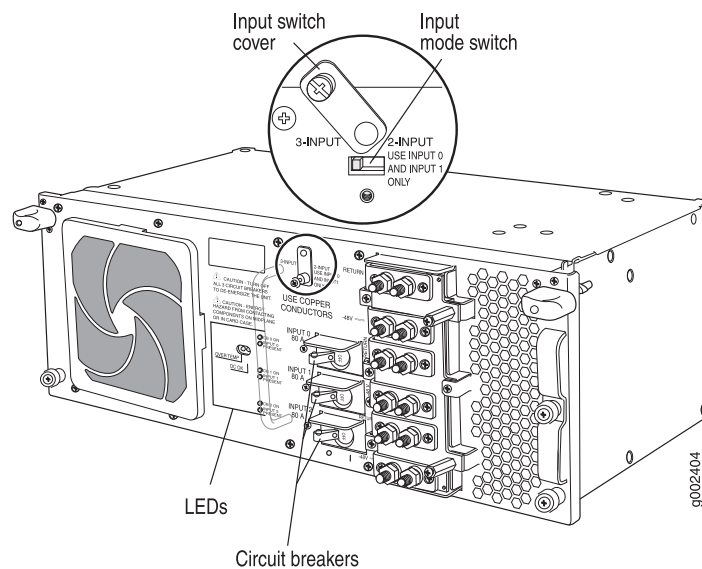
Figure 16: Three-Input 240-A Power Supply with the Optional Cable Restraint

LEDs

Circuit breakers

Optional cable restraint
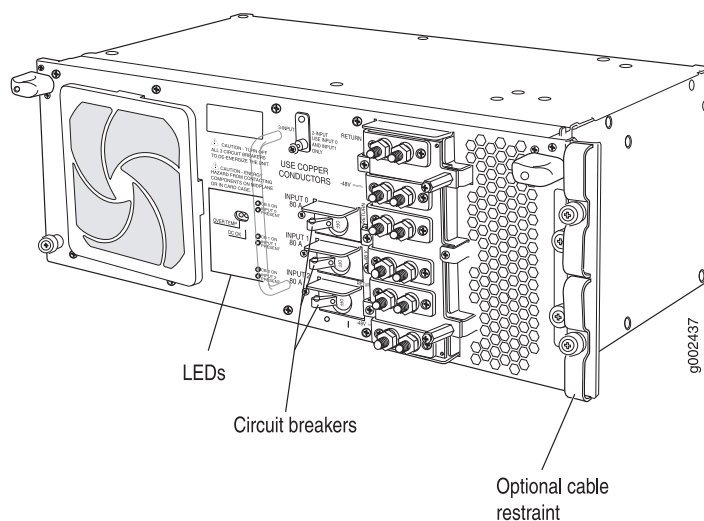
To replace the cable restraint on a three-input 240-A power supply, use the following procedures:

- Removing the Standard Cable Restraint from a Three-Input 240-A Power Supply on page 24

- Installing the Optional Cable Restraint on a Three-Input 240-A Power Supply on page 24

Removing the Standard Cable Restraint from a Three-Input 240-A Power Supply

The cable restraint is located on the right edge of the power supply faceplate. To remove the standard cable restraint, follow this procedure:

1. Loosen the captive screw on the standard cable restraint.

2. Remove the cable restraint from the power supply.

Installing the Optional Cable Restraint on a Three-Input 240-A Power Supply

To install the optional cable restraint, follow this procedure:

1. Align the two captive screws on the optional cable restraint with the two threaded holes located at the right edge of the power supply faceplate.

2. Fasten the captive screws.

Connecting a Three-Input 240-A Power Supply

To connect a three-input 240-A power supply to the power sources, follow this procedure:

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis. See "Preventing Electrostatic Discharge Damage" on page 47.

2. Verify that a licensed electrician has attached cable lugs to the power cables that you supply.

3. Verify that the voltage across the DC power source cables leads is 0 V and that there is no chance that the cables might become active during installation. If needed, switch off the external circuit breakers.

4. Verify that the circuit breakers on the power supply faceplate are in the OFF position (O).

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

6. Remove the nut and washer from each power terminal stud.

⚠ **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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7. Attach the lugs on the DC source power cables to the terminal studs.

    a. Attach the positive (+) DC source power cable lugs to the RETURN (return) terminals.

    b. Attach the negative (–) DC source power cable lugs to the –48V (input) terminals.

    Secure the cable lugs to the terminal studs, first with a washer, then with a nut (see Figure 17 on page 26). Use a 7/16-in. (11-mm) nut driver or wrench to tighten the nut. Apply between 23 lb-in. (2.6 Nm) and 25 lb-in. (2.8 Nm) of torque to each nut.

☞ **NOTE:** For power supplies set to 3-INPUT mode (required for the T1600 routing node), connect two DC power cables to each of the three inputs.

---

8. Loosen the captive screw or screws on the cable restraint on the right edge of the power supply faceplate.

9. Route the DC power cables through the cable restraint.

10. Tighten the cable restraint captive screw or screws to hold the power cables in place.

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

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

Figure 17: Connecting Power Cables to the Power Supply
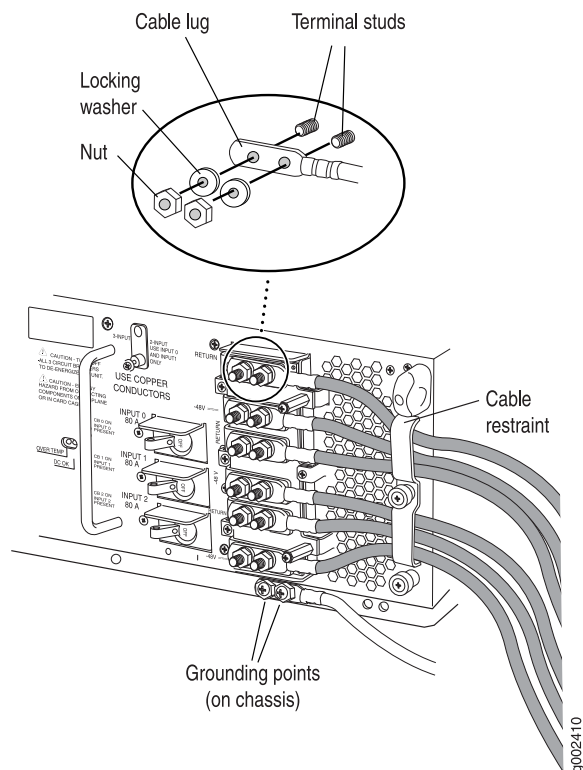
Powering On a Three-Input 240-A Power Supply

To power on a three-input 240-A power supply, follow this procedure:

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis. See "Preventing Electrostatic Discharge Damage" on page 47.

2. Switch on the external circuit breakers to provide voltage to the DC power source cables.

3. Verify that the **INPUT PRESENT** LEDs on the power supply faceplate are lit steadily, indicating that the inputs are receiving power.

4. Switch the circuit breakers on the power supply to the **ON** position (|).

☞ **NOTE:** After a power supply is powered on, it can take up to 60 seconds for status indicators—such as the LEDs on the power supply, the show chassis command display, and messages on the LED display on the craft interface—to indicate that the power supply is functioning normally. Ignore error indicators that appear during the first 60 seconds.

5. Verify that the **CB ON** LEDs on the power supply faceplate are lit steadily. The **CB ON** LEDs blink momentarily, then light steadily to indicate that the circuit breakers are on.

6. Verify that the **DC OK** LED on the power supply faceplate is lit steadily, indicating that the power supply is correctly installed and is functioning properly.

☞ **NOTE:** After powering on a power supply, wait at least 60 seconds before turning it off. If the system is completely powered off when you power on the power supply, the Routing Engine boots as the power supply completes its startup sequence. If the Routing Engine finishes booting and you need to power off the system again, first issue the CLI request system halt command.

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

Upgrading SIBs

To convert an operational T640 routing node to a T1600 routing node, you upgrade the standard SIBs or SIBs version B in the T640 routing node to T1600-SIBs. You repeat the upgrade procedures for each of the five SIBs in the routing node.

☞ **NOTE:** During the SIB upgrade:

■ The routing node should not experience packet loss if the traffic is less than 50 percent per Packet Forwarding Engine in each FPC.

■ The routing node might experience some packet loss if the traffic is more than 50 percent per Packet Forwarding Engine in each FPC, depending on the operational environment.

For more information, contact your customer support representative.

■ Overview of Upgrading the SIBs on page 28

■ Preparing to Upgrade the SIBs on page 29

■ Tools Required on page 30

■ Removing a Standard SIB or SIB Version B on page 30

■ Installing a T1600-SIB on page 32

- Verifying the Installation of a T1600-SIB on page 33

- Preparing to Exit Upgrade Mode on page 33

- Exiting Upgrade Mode on page 34

- Verifying Operation on page 35

Overview of Upgrading the SIBs

To replace the standard SIBs or SIB version B in a T640 routing node with T1600-SIBs, follow these procedures:

1. Identify the spare SIB.

2. Upgrade the spare SIB.

   a. Remove the spare SIB using the procedure "Removing a Standard SIB or SIB Version B" on page 30.

   b. Install a T1600-SIB in the slot where the spare SIB was located. See "Installing a T1600-SIB" on page 32

3. Remove one of the remaining standard SIBs or SIB version B and install a T1600-SIB. Then, repeat the procedures for each of the remaining SIBs.

Preparing to Upgrade the SIBs

To prepare to upgrade the SIBs, follow this procedure:

1. The T640 routing node must contain five standard SIBs or SIBs version B before the upgrade. Verify that four SIBs are in the **Online** state and one SIB is in the **Spare** state. Display the status of the SIBs by issuing the show chassis sibs command:

   ```
   user@host> show chassis sibs
   ```

   ```
   Slot  State            Uptime
    0    Spare            255 days, 31 minutes, 12 seconds
    1    Online           255 days, 31 minutes, 12 seconds
    2    Online           255 days, 31 minutes, 12 seconds
    3    Online           255 days, 31 minutes, 12 seconds
    4    Online           255 days, 31 minutes, 12 seconds
   ```

   To bring a SIB online, issue the request chassis sib online operational mode command. To install additional SIBs, use the standard installation procedure described in the *T640 Internet Routing Node Hardware Guide*.

   ☞ **NOTE:** Do not proceed with the upgrade until all five SIBs are present and operational.

2. Enter configuration mode.

   ```
   user@host> configure
   ```

3. Include the fabric upgrade-mode statement in the configuration at the [edit chassis] hierarchy level.

   ```
   user@host# set chassis fabric upgrade-mode
   ```

4. Commit the configuration:
   - If GRES is enabled, commit the configuration on both the master and the backup Routing Engines:

     ```
     user@host# commit synchronize
     ```

   - If GRES is not enabled, commit the configuration on the master Routing Engine:

     ```
     user@host# commit
     ```

5. Exit configuration mode.

```
user@host# exit
```

Tools Required

To upgrade the SIBs, you need the following tools and parts.

■   Electrostatic discharge (ESD) grounding wrist strap

■   Phillips (+) screwdrivers, numbers 1 and 2

Removing a Standard SIB or SIB Version B

To remove a standard SIB or SIB version B, follow this procedure:

1.   Attach an electrostatic discharge (ESD) grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis. See "Preventing Electrostatic Discharge Damage" on page 47.

2.   Take the SIB offline by using one of the following methods:

   ■   Press and hold the **ONLINE/OFFLINE** button on the SIB faceplate for about five seconds until the **OK** LED is not lit.

   ■   Issue the **request chassis sib offline** command. For example:

   ```
   user@host> request chassis sib offline slot 0
   ```

☞   **NOTE:** When you bring an active SIB offline, the spare SIB becomes active and transitions to the **Online** state.

3.   Loosen the captive screws (using a Phillips (+) screwdriver, number 2) on the ejector handles on each side of the SIB faceplate.

4.   Flip the ejector handles outward to unseat the SIB.

5.   Grasp both ejector handles, pull firmly, and slide the SIB about three-quarters of the way out of the chassis.

6.   Place one hand underneath the SIB to support it and slide it completely out of the chassis. Place the SIB on the antistatic mat.

⚠   **CAUTION:** Do not stack hardware components on one another after you remove them. Place each component on an antistatic mat resting on a stable, flat surface.

Figure 18: Removing a SIB from a T640 Routing Node
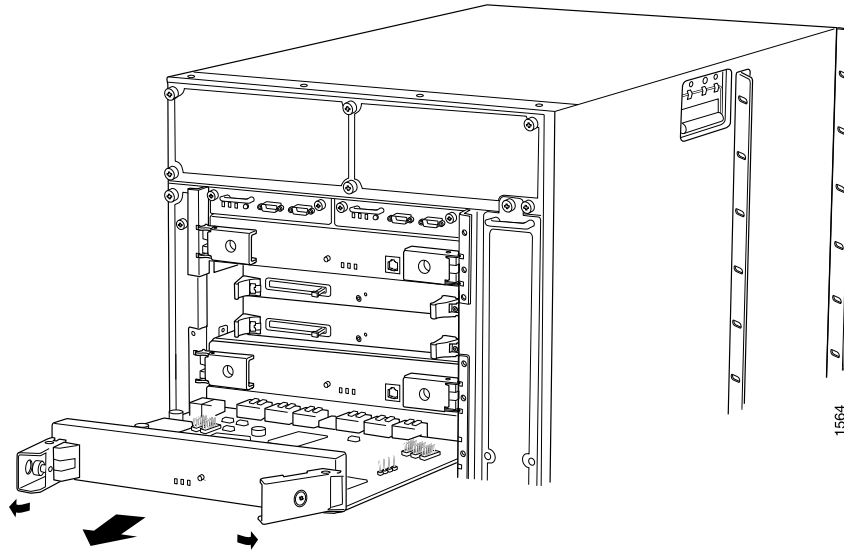
Figure 19: Standard SIB Supported in a T640 Routing Node

Extractor clip

LEDs   Online/offline
button

Extractor clip
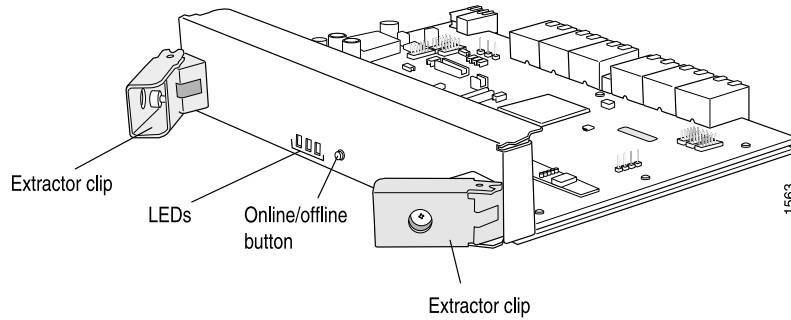
Installing a T1600-SIB

Each SIB weighs approximately 6.5 lb (3 kg). To install a T1600-SIB, follow this procedure (see Figure 20 on page 32):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis. See "Preventing Electrostatic Discharge Damage" on page 47.

2. Place one hand underneath the T1600-SIB to support it. With the other hand, hold one of the ejector handles on the T1600-SIB faceplate.

3. Carefully align the sides of the T1600-SIB with the guides inside the chassis.

4. Slide the T1600-SIB into the chassis, carefully ensuring that it is correctly aligned.

5. Grasp both ejector handles and press them inward to seat the T1600-SIB. Ensure that the ejector handle tabs are properly mated inside their corresponding chassis slots. You might have to close and open the handles a few times before the tabs catch the slots.

6. Tighten the captive screws on the ejector handles.

7. Bring the T1600-SIB online using one of the following methods:

    ■   Press and hold the **ONLINE/OFFLINE** button on the T1600-SIB faceplate. The green **OK** LED on the faceplate begins to blink. Hold the button down until the LED blinks.

    ■   Issue the following CLI command on the routing node:

    ```
    user@host> request chassis sib online slot 0
    ```

Figure 20: Installing a T1600-SIB in a T1600
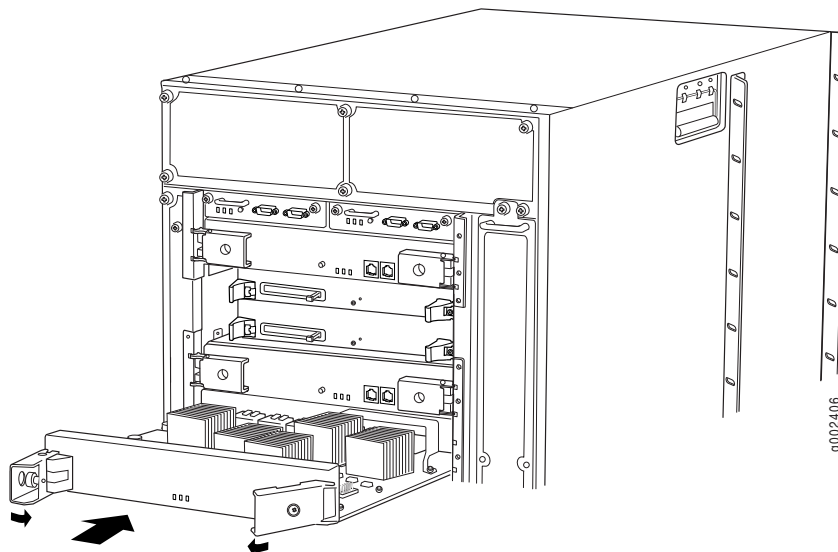
Verifying the Installation of a T1600-SIB

To verify that the T1600-SIB is functioning normally, follow this procedure:

1. Check the LEDs on the T1600-SIB faceplate.

    ■ The green **OK** LED should light steadily a few minutes after the T1600-SIB is installed.

    ■ If the **FAIL** LED is lit steadily, remove and install the T1600-SIB again. Make sure that the T1600-SIB is seated properly. If the **FAIL** LED still lights steadily, the T1600-SIB is not functioning properly. Contact your customer support representative.

2. Verify that four T1600-SIB are in the **Online** state and one SIB is in the **Spare** state. Display the status of the T1600-SIB by issuing the **show chassis sibs** command:

    ```
    user@host> show chassis sibs

    Slot  State             Uptime
    0     Spare             0 days, 30 minutes, 12 seconds
    1     Online            0 days, 25 minutes, 45 seconds
    2     Online            0 days, 20 minutes, 28 seconds
    3     Online            0 days, 15 minutes, 7 seconds
    4     Online            0 days, 10 minutes, 52 seconds
    ```

    To bring a T1600-SIB online, issue the **request chassis sib online** operational mode command.

Preparing to Exit Upgrade Mode

After all five T1600-SIBs have been installed, use the following commands to exit upgrade mode :

1. Determine if GRES is enabled.

    ```
    user@host> show system switchover

    Graceful switchover: On
    Configuration database: Ready
    Kernel database: Ready
    ```

2. Verify that the Routing Engines are operating properly by issuing the **show chassis routing-engine** command.

    ```
    user@host> show chassis routing-engine

    Routing Engine status:
      Slot 0:
        Current state            Master
        Election priority        Master (default)
        Temperature              32 degrees C / 89 degrees F
        CPU temperature          33 degrees C / 91 degrees F
    ```

```
DRAM                          2048 MB
Memory utilization               8 percent
CPU utilization:
  User                           0 percent
  Background                     0 percent
  Kernel                         2 percent
  Interrupt                      0 percent
  Idle                          98 percent
Model                         RE-4.0
Serial ID                     P13004101110
Start time                    2007-04-30 08:38:22 PDT
Uptime                        2 days, 2 hours, 22 minutes, 43 seconds

Load averages:                1 minute   5 minute  15 minute
                                 0.02       0.02       0.00
```

Exiting Upgrade Mode

Use the following commands to exit upgrade mode:

1. Enter configuration mode.

   `user@host>` **`configure`**

2. Delete the fabric upgrade-mode statement in the configuration at the [edit chassis] hierarchy level.

   `user@host#` **`delete chassis fabric upgrade-mode`**

3. Commit the configuration:

   ■   If GRES is enabled, commit the configuration on both the master and the backup Routing Engines:

   `user@host#` **`commit synchronize`**

   ■   If GRES is not enabled, commit the configuration on the master Routing Engine:

   `user@host#` **`commit`**

4. Exit configuration mode.

   `user@host#` **`exit`**

Verifying Operation

Use the following commands to verify proper operation of the T1600 routing node:

1. Verify that the model number is now T1600 by issuing the show version command.

```
user@host> show version

Hostname: myhost
Model: t1600
JUNOS Base OS boot [8.5R1]
JUNOS Base OS Software Suite [8.5R1]
JUNOS Kernel Software Suite [8.5R1]
JUNOS Crypto Software Suite [8.5R1]
JUNOS Packet Forwarding Engine Support (M/T Common) [8.5R1] JUNOS Packet Forwarding Engine Support
(T-Series) [8.5R1] JUNOS Online Documentation [8.5R1] JUNOS Routing Software Suite [8.5R1]
```

2. Verify that no alarms are present by issuing the show chassis alarms command.

```
user@host> show chassis alarms

No alarms currently active
```

3. Verify that the LEDs and indicators on the craft interface show that the routing node is operating properly by issuing the show chassis craft-interface command.

```
user@host> show chassis craft-interface

FPM Display contents:
    +-------------------+
    |Myhost router      |
    |Up: 0+22:34        |
    |                   |
    |Temperature OK     |
    +-------------------|

Front Panel System LEDs:
Routing Engine    0    1
-------------------------
OK                *    *
Fail              .    .
Master            *    .

Front Panel Alarm Indicators:
---------------------------
Red LED      .
Yellow LED   .
Major relay  .
Minor relay  .

Front Panel FPC LEDs:
FPC    0   1   2   3   4   5   6   7
------------------------------------
Red    .   .   .   .   .   .   .   .
Green  *   *   *   *   *   *   *   *

CB LEDs:
```

```
  CB   0   1
--------------
Amber  .   .
Green  *   *
Blue   *   .

SCG LEDs:
  SCG  0   1
--------------
Amber  .   .
Green  *   *
Blue   *   .

SIB LEDs:
  SIB  0   1   2   3   4
-------------------------
Red    .   .   .   .   .
Green  *   *   *   *   *
```

4.   Verify that all FPCs in the routing node are detected and online by issuing the
     show chassis fpc and show chassis hardware commands.

user@host> **show chassis fpc**

```
                  Temp  CPU Utilization (%)   Memory    Utilization (%)
Slot State        (C)  Total  Interrupt    DRAM (MB) Heap     Buffer
   0  Online       41     6        0          1024     6        49
   1  Online       35     4        0          1024     4        49
   2  Online       35     4        0          1024     4        49
   3  Online       31     1        0          1024     2        49
   4  Online       33     1        0          1024     2        49
   5  Online       56     9        0          2048     5        24
   6  Online       35     4        0          1024     4        49
   7  Online       32     1        0          1024     2        49
```

user@host> **show chassis hardware**

```
Hardware inventory:
Item            Version  Part number  Serial number  Description
Chassis                               JN1090E5DAHA   T1600
Midplane        REV 02   710-017247   RC0094         T640 Backplane
FPM GBUS        REV 09   710-002901   WE0156         T640 FPM Board
FPM Display     REV 05   710-021387   DE4543         T1600 FPM Display
CIP             REV 06   710-002895   WD8691         T-series CIP
PEM 0           Rev 06   740-017906   TE27790        Power Entry Module 3x80
PEM 1           Rev 06   740-017906   TE27779        Power Entry Module 3x80
SCG 0           REV 14   710-003423   WF1874         T640 Sonet Clock Gen.
SCG 1           REV 14   710-003423   WF1881         T640 Sonet Clock Gen.
Routing Engine 0 REV 06  740-014082   1000688671     RE-A-2000
Routing Engine 1 REV 06  740-014082   1000688739     RE-A-2000
CB 0            REV 06   710-007655   KB9648         Control Board (CB-T)
CB 1            REV 15   710-002728   HR8130         T-series Control Board
FPC 0           REV 10   710-010845   JZ2728         FPC Type 4
  CPU           REV 04   710-011481   JT8139         FPC CPU-Enhanced
  PIC 0         REV 05   750-017405   DF3515         4x 10GE (LAN/WAN) XFP
    Xcvr 0      REV 01   740-014279   KB405P1        XFP-10G-LR
    Xcvr 1      REV 01   740-014289   C701XU05U      XFP-10G-SR
  MMB 0         REV 01   710-016606   JW7943         ST-MMB
```

```
FPC 1           REV 03   710-013035  DF5574      FPC Type 3-ES
  CPU
FPC 2           REV 04   710-013560  WF7206      E2-FPC Type 3
  CPU           REV 03   710-013563  WE9007      FPC CPU-Enhanced
  PIC 0         REV 16   750-007141  NF5528      10x 1GE(LAN), 1000 BASE
    Xcvr 0      REV 01   740-011782  P8P085F     SFP-SX
  PIC 1         REV 12   750-009567  WF3566      1x 10GE(LAN),XENPAK
    Xcvr 0      REV 02   740-013170  T07C94489   XENPAK-LR
  PIC 2         REV 11   750-009567  CW9479      1x 10GE(LAN),XENPAK
    Xcvr 0      REV 02   740-013170  T06F90331   XENPAK-LR
  PIC 3         REV 07   750-012793  WF5106      1x 10GE(LAN/WAN) IQ2
    Xcvr 0      REV 01   740-014279  KB405Q8     XFP-10G-LR
  MMB 0         REV 06   710-010171  WF6759      MMB-5M3-288mbit
  MMB 1         REV 06   710-010171  WF6800      MMB-5M3-288mbit
FPC 3           REV 04   710-013553  JW1482      E2-FPC Type 1
  CPU           REV 02   710-013563  JY4119      FPC CPU-Enhanced
  PIC 0         REV 10   750-012266  JX5515      4x 1GE(LAN), IQ2
    Xcvr 0      REV 01   740-011613  PAM2Y9H     SFP-SX
    Xcvr 1      REV 01   740-011613  PAM2Y99     SFP-SX
    Xcvr 2      REV 01   740-011613  AM07287E42  SFP-SX
    Xcvr 3      REV 01   740-011613  PAJ4SQL     SFP-SX
  PIC 1         REV 04   750-011209  HY3332      Adaptive Services-II
  PIC 2         REV 03   750-011750  JH4537      Adaptive Services-II FIPS
  MMB 1         REV 05   710-008923  JS8106      MMB 3M 288-bit
FPC 4           REV 04   710-013558  JX5622      E2-FPC Type 2
  CPU           REV 02   710-013563  JT5841      FPC CPU-Enhanced
  PIC 3         REV 21   750-001901  HZ6258      4x OC-12 SONET, SMIR
  MMB 1         REV 05   710-010171  JY3756      MMB-5M3-288mbit
FPC 5           REV 10   710-010845  JZ2728      FPC Type 4
  CPU           REV 04   710-011481  JT8139      FPC CPU-Enhanced
  PIC 0         REV 01   750-010850  JA0329      1x OC-768 SONET SR
  MMB 0         REV 01   710-016606  JW7943      ST-MMB
FPC 6           REV 10   710-010845  JZ2729      FPC Type 4
  CPU           REV 04   710-011481  JT8138      FPC CPU-Enhanced
  PIC 0         REV 01   750-010850  JA0324      1x OC-768 SONET SR
  MMB 0         REV 01   710-016606  JW7942      ST-MMB
FPC 7           REV 05   710-013558  WF4779      E2-FPC Type 2
  CPU           REV 03   710-013563  WF4663      FPC CPU-Enhanced
  PIC 0         REV 09   750-011800  KA2397      8x 1GE(LAN), IQ2
    Xcvr 0      REV 01   740-007326  P5S0PD9     SFP-SX
    Xcvr 1      REV 01   740-007326  P5S0PD6     SFP-SX
    Xcvr 2      REV 01   740-011613  PAJ4SQV     SFP-SX
    Xcvr 3      REV 01   740-011613  PAM2Y94     SFP-SX
    Xcvr 5      REV 01   740-011613  P9R0AJV     SFP-SX
    Xcvr 7      REV 01   740-013111  70191002    SFP-T
  MMB 1         REV 06   710-010171  WF4050      MMB-5M3-288mbit
SPMB 0          REV 10   710-003229  JZ1095      T-series Switch CPU
SPMB 1          REV 09   710-003229  HR8670      T-series Switch CPU
SIB 0           REV 05   710-013074  DE7894      SIB-I8-SF
SIB 1           REV 05   710-013074  DE7916      SIB-I8-SF
SIB 2           REV 05   710-013074  DE7890      SIB-I8-SF
SIB 3           REV 05   710-013074  DE7883      SIB-I8-SF
SIB 4           REV 05   710-013074  DE7913      SIB-I8-SF
```

5. Verify that all interfaces in the routing node are up by issuing the show interfaces terse command:

```
user@host> show interfaces terse
```

```
Interface              Admin Link Proto   Local             Remote
xe-0/0/0               up    up
xe-0/0/1               up    down
xe-0/0/2               up    down
xe-0/0/3               up    down
ge-2/0/0               up    down
ge-2/0/1               up    down
ge-2/0/2               up    down
ge-2/0/3               up    down
ge-2/0/4               up    down
ge-2/0/5               up    down
ge-2/0/6               up    down
ge-2/0/7               up    down
ge-2/0/8               up    down
ge-2/0/9               up    down
ge-2/1/0               up    up
ge-2/2/0               up    up
pc-2/3/0               up    up
pc-2/3/0.16383         up    up   inet    10.0.0.1          --> 10.0.0.51
                                          10.0.0.6          --> 0/0
xe-2/3/0               up    down
ge-3/0/0               up    up
pc-3/0/0               up    up
pc-3/0/0.16383         up    up   inet    10.0.0.1          --> 10.0.0.64
                                          10.0.0.6          --> 0/0
ge-3/0/1               up    up
ge-3/0/2               up    down
ge-3/0/3               up    up
gr-3/1/0               up    up
ip-3/1/0               up    up
mt-3/1/0               up    up
pd-3/1/0               up    up
pe-3/1/0               up    up
sp-3/1/0               up    up
sp-3/1/0.16383         up    up   inet    10.0.0.1          --> 10.0.0.65
vt-3/1/0               up    up
gr-3/2/0               up    up
ip-3/2/0               up    up
mt-3/2/0               up    up
pd-3/2/0               up    up
pe-3/2/0               up    up
sp-3/2/0               up    up
sp-3/2/0.16383         up    up   inet    10.0.0.1          --> 10.0.0.66
vt-3/2/0               up    up
so-4/3/0               up    up
so-4/3/1               up    down
so-4/3/2               up    down
so-4/3/3               up    down
so-5/0/0               up    up
so-5/1/0               up    up
so-5/1/1               up    up
so-5/1/2               up    down
so-5/1/3               up    down
ge-7/0/0               up    up
pc-7/0/0               up    up
pc-7/0/0.16383         up    up   inet    10.0.0.1          --> 10.0.0.128
                                          10.0.0.6          --> 0/0
ge-7/0/1               up    up
ge-7/0/2               up    down
ge-7/0/3               up    up
ge-7/0/4               up    down
```

```
ge-7/0/5                up    down
ge-7/0/6                up    down
ge-7/0/7                up    up
bcm0                    up    up
bcm0.0                  up    up    inet    10.0.0.4/8
                                    inet6   fe80::200:ff:fe00:4/64
                                            fec0::a:0:0:4/64
                                    tnp     4
dsc                     up    up
em0                     up    up
em0.0                   up    up    inet    10.0.0.4/8
                                    inet6   fe80::200:1ff:fe00:4/64
                                            fec0::a:0:0:4/64
                                    tnp     4
fxp0                    up    up
fxp0.0                  up    up    inet    192.168.168.34/22
gre                     up    up
ipip                    up    up
lo0                     up    up
lo0.0                   up    up    inet    10.255.168.34       --> 0/0
                                            127.0.0.1           --> 0/0
                                    iso     47.0005.80ff.f800.0000.0108.0001.0102.5516.8034
                                    inet6   abcd::10:255:168:34
                                            fe80::2a0:a5ff:fe5e:59f5
lo0.16384               up    up    inet    127.0.0.1           --> 0/0
lo0.16385               up    up    inet
lsi                     up    up
mtun                    up    up
pimd                    up    up
pime                    up    up
tap                     up    up
```

After you have verified operation, you can install T1600-FPC4s.

Removing the Upper Front Fan Tray

☞ **NOTE:** Remove the front upper fan tray to make the craft interface easier to replace and to avoid injury and damaging the equipment.

The upper front fan tray is located above the FPC card cage. The fan tray weighs about 18.6 lb (8.4 kg). To remove the upper front fan tray, follow this procedure (see Figure 21 on page 40):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis. See "Preventing Electrostatic Discharge Damage" on page 47.

2. Loosen the captive screws on the corners of the fan tray faceplate.

3. Grasp the handles and pull the fan tray halfway out of the chassis.

> ⚡ **WARNING:** To avoid injury, keep tools and your fingers away from the fans as you slide the fan tray out of the chassis. The fans might still be spinning.

4. When the fans stop spinning, place one hand under the fan tray to support it and pull the fan tray completely out of the chassis.

Figure 21: Removing a Front Fan Tray
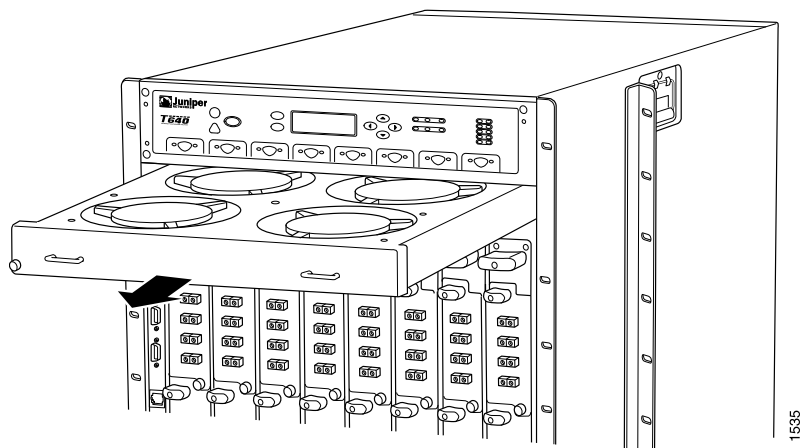
Replacing the Craft Interface

The craft interface is hot-insertable and hot-removable. When you install the craft interface, allow several minutes for the display to reflect the current state of the T1600 routing node. Before you remove the craft interface, remove the front upper fan tray. For instructions on removing a front fan tray, see "Removing the Upper Front Fan Tray" on page 39

To replace the craft interface, use the following procedures:

■ Removing the Craft Interface on page 40

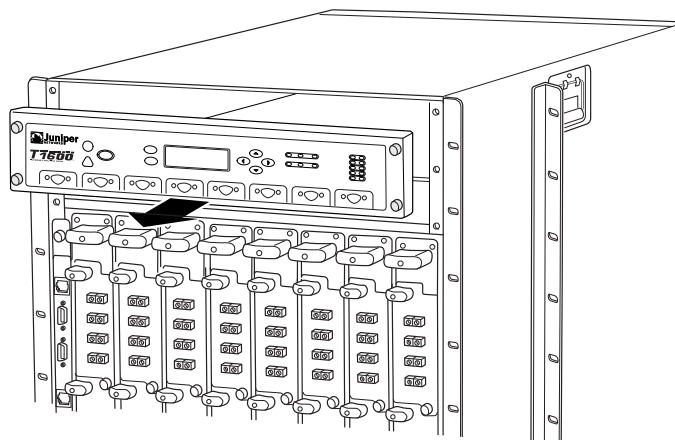■ Installing the Craft Interface on page 41

Removing the Craft Interface

The craft interface is located on the front of the chassis above the FPC card cage. The craft interface weighs approximately 2 lb (0.9 kg). To remove the craft interface, follow this procedure (see Figure 22 on page 41):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis. See "Preventing Electrostatic Discharge Damage" on page 47.

2. Completely loosen the screws at the four corners of the craft interface.

3. Insert the blade of a flat-blade screwdriver into the slot on one side of the craft interface, then gently pry that side out from the chassis.

4. Repeat Step 3 for the other side of the craft interface.

5. Grasp the craft interface by the top and bottom edges and carefully pull it straight out of the chassis.

Figure 22: Removing the Craft Interface

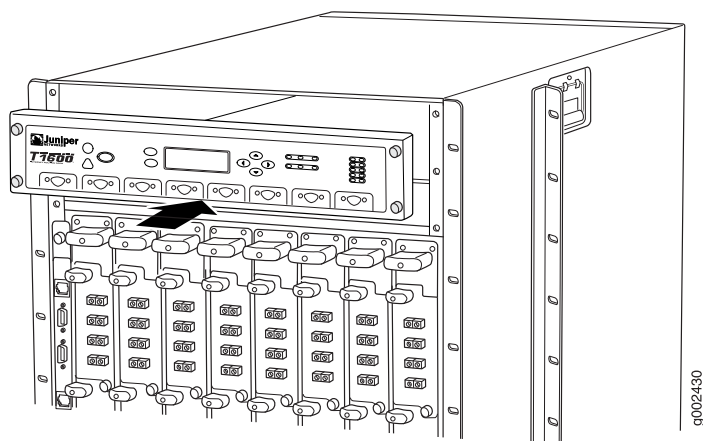## *Installing the Craft Interface*

To install the craft interface, follow this procedure (see Figure 23 on page 42):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis. See "Preventing Electrostatic Discharge Damage" on page 47.

2. Grasping the craft interface by the top and bottom edges, press it into place.

3. Tighten the screws at the corners of the craft interface.

☞ **NOTE:** When you install the craft interface in an operating T1600 routing node, allow several minutes for the LEDs on the craft interface to reflect the current state of the T1600 routing node.

After you install the replacement craft interface, immediately reinstall the upper front fan tray.

Figure 23: Installing a Replacement Craft Interface

Installing the Upper Front Fan Tray

To install the upper front fan tray, follow this procedure (see Figure 24 on page 42):

1. Attach an electrostatic discharge (ESD) grounding strap to your bare wrist and connect the strap to one of the ESD points on the chassis. See "Preventing Electrostatic Discharge Damage" on page 47.

2. Grasp the fan tray by its handles and insert it straight into the chassis.

3. Tighten the captive screws on each side of the fan tray faceplate to secure it in the chassis.

Figure 24: Installing a Front Fan Tray
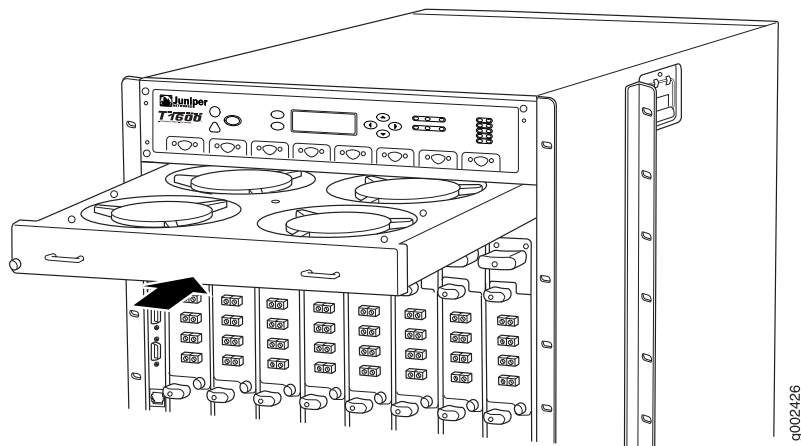
Attaching the T1600 Agency Label

To attach the T1600 agency label, follow this procedure:

1. Locate the T640 agency label on the side of the chassis.

2. Peel the protective backing off the T1600 agency label.

3. Apply the T1600 agency label on top of the T640 agency label.

Registering Your T1600 Upgrade

You must register the T1600 upgrade with Juniper upon completion of the upgrade. To register your upgrade:

1. Log on to the Juniper Customer Support Center at http://www.juniper.net/customers/support/.

2. Click on Update Install Base.

3. Follow the instructions provided in this link.

After your T600 upgrade is registered, allow up to 45 days for restocking of the new hardware configuration to support any Next Day or Same Day contracts. Juniper Networks will provide Best Effort support until restocking of the upgraded product is complete.

T1600 Routing Node Environmental Specifications

Table 5 on page 44 specifies the environmental specifications required for normal T1600 routing node operation.

Table 5: T1600 Routing Node Environmental Specifications

Description	Value
Altitude	No performance degradation to 10,000 ft (3048 m)
Relative humidity	Normal operation ensured in relative humidity range of 5% to 90%, noncondensing
Temperature	Normal operation ensured in temperature range of 32°F (0°C) to 104°F (40°C) Nonoperating storage temperature in shipping crate: –40°F (–40°C) to 158°F (70°C)
Seismic	Designed to meet Telcordia Technologies Zone 4 earthquake requirements
Maximum thermal output	28,500 BTU/hour est (8350 W) **NOTE:** These specifications are estimates and subject to change.

T1600 Routing Node DC Power Specifications

This section contains specifications for the power system, power supply, and DC power cables.

- Power System Electrical Specifications on page 44
- Three-Input 240-A Power Supply Specifications on page 45
- DC Power Cable Specifications on page 46

Power System Electrical Specifications

Table 6 on page 45 lists the power system electrical specifications.

Table 6: Power System Electrical Specifications

Item	Specification
DC input voltage	Operating range: –40.0 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 –44.0 VDC, the router automatically starts up again and the system returns to normal operation within 30 minutes. No operator intervention is required.
DC system current rating	174 A @ –48 VDC (nominal)
DC system input power	8350 W

Three-Input 240-A Power Supply Specifications

Table 7 on page 45 lists the power supply electrical specifications.

Table 7: Power Supply Electrical Specifications

Item	Specification
DC input voltage	Nominal –48 VDC, –60 VDC Operating range: –40.0 to –72.0 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.
Input DC current rating	Input 0: 46 A @ –48 VDC (nominal)
	Input 1: 64 A @ –48 VDC (nominal)
	Input 2: 64 A @ –48 VDC (nominal)

☞ **NOTE:** If you plan to operate a maximally configured T1600 routing node, we recommend that you provision at least 64 A @ −48 VDC for each power supply input in the system. Although **Input 0** requires less power, we recommend provisioning the same amount of power for each input to avoid the possibility of connecting the lower-powered DC cable to **Input 1** or **Input 2**.

Use a facility circuit breaker rated for 80 A (−48 VDC) minimum for each power supply input. Doing so enables you to operate the T1600 routing node in any configuration without upgrading the power infrastructure. You must provision a circuit breaker for each DC power supply input rated for at least 125% of the continuous current that the system draws at −48 VDC.

DC Power Cable Specifications

Table 8 on page 46 summarizes the specifications for the DC power cables, which you supply. For two of the inputs on each power supply, use the DC power cables and lugs that were connected to the two-input 160-A power supply. Four additional DC power cables are required. The accessory box shipped with the T1600 upgrade kit includes four cable lugs that attach to the terminal studs of the additional third input on each three-input 240-A power supply (see Figure 25 on page 46).
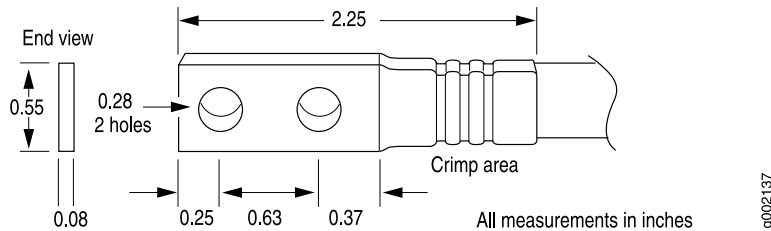
Figure 25: DC Power Cable Lug

Table 8: DC Power Cable Specifications

Cable Type	Quantity and Specification
Power	Four 4-AWG (21.2 mm^2), minimum 90°C wire, or as permitted by the local code

Preventing Electrostatic Discharge Damage

Many T1600 routing node hardware components are sensitive to damage from static electricity. Some components can be impaired by voltages as low as 30 V. You can easily generate potentially damaging static voltages whenever you handle plastic or foam packing material or if you move components across plastic or carpets. Observe the following guidelines to minimize the potential for electrostatic discharge (ESD) damage, which can cause intermittent or complete component failures:

■   Always use an ESD wrist strap or ankle strap, and verify that it is in direct contact with your skin.

⚠   **CAUTION:** For safety, periodically check the resistance value of the ESD strap. The measurement should be in the range of 1 to 10 Mohms.

■   When handling any component that is removed from the chassis, verify that the equipment end of your ESD strap is attached to one of the ESD points on the chassis, which are shown in Figure 1 on page 4 and Figure 2 on page 5.

■   Avoid contact between the component and your clothing. ESD voltages emitted from clothing can still damage components.

■   When removing or installing a component, always place it component-side up on an antistatic surface, in an antistatic card rack, or in an electrostatic bag (see Figure 26 on page 47). If you are returning a component, place it in an electrostatic bag before packing it.

Figure 26: Placing a Component into an Electrostatic Bag
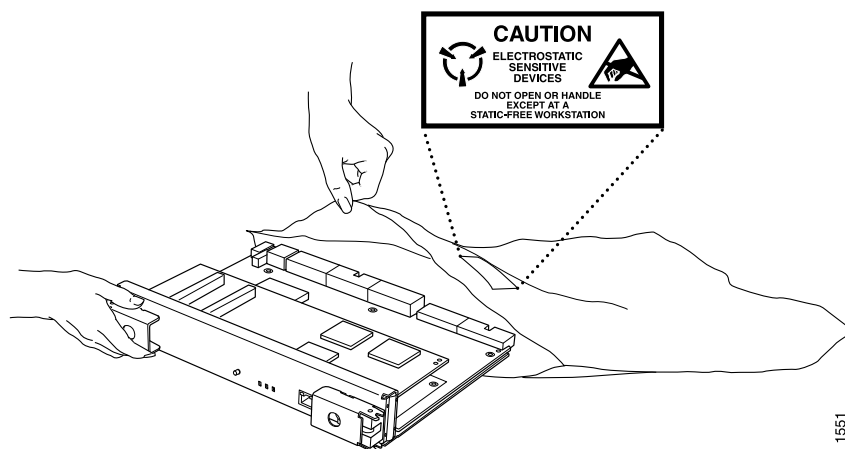
List of Technical Publications

Table 9 on page 48 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 10 on page 52 lists the books included in the *Network Operations Guide* series. Table 11 on page 53 lists the manuals and release notes supporting JUNOS software with enhanced services. All documents are available at http://www.juniper.net/techpubs/.

Table 12 on page 54 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 9: 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.
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 active 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.

Table 9: Technical Documentation for Supported Routing Platforms *(continued)*

Book	Description
MX-series Solutions Guide	Describes common configuration scenarios for the Layer 2 features supported on the MX-series routers, including basic bridged VLANs with normalized VLAN tags, aggregated Ethernet links, bridge domains, Multiple Spanning Tree Protocol (MSTP), and integrated routing and bridging (IRB).
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.
Protected System Domain	Provides an overview of the JCS 1200 platform and the concept of Protected System Domains (PSDs). The JCS 1200 platform, which contains up to six redundant pairs of Routing Engines running JUNOS software, is connected to a T320 router or to a T640 or T1600 routing node. To configure a PSD, you assign any number of Flexible PIC concentrators (FPCs) in the T-series routing platform to a pair of Routing Engines on the JCS 1200 platform. Each PSD has the same capabilities and functionality as a physical router, with its own control plane, forwarding plane, and administration.
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.
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	

Table 9: Technical Documentation for Supported Routing Platforms *(continued)*

Book	Description
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.
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.
Hardware Documentation	

Table 9: Technical Documentation for Supported Routing Platforms *(continued)*

Book	Description
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	
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	
Advanced Insight Solutions Guide	Describes the Advanced Insight Manager (AIM) application, which provides a gateway between JUNOS devices and Juniper Support Systems (JSS) for case management and intelligence updates. Explains how to run AI scripts on Juniper Networks devices.
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.

Table 9: Technical Documentation for Supported Routing Platforms *(continued)*

Book	Description
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 Release Notes	Summarize AIS new features and guidelines, identify known and resolved problems, provide information that might have been omitted from the manuals, and provide initial setup, upgrade, and downgrade procedures.
AIS AI Script Release Notes	Summarize AI Scripts new features, identify known and resolved problems, provide information that might have been omitted from the manuals, and provide instructions for automatic and manual installation, including deleting and rolling back.
J-series Services Router Release Notes	Briefly describe Services Router features, identify known hardware problems, and provide upgrade and downgrade instructions.

Table 10: 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.

To configure and operate a J-series Services Router running JUNOS software with enhanced services, you must also use the configuration statements and operational

mode commands documented in JUNOS configuration guides and command references. To configure and operate a WX Integrated Services Module, you must also use WX documentation.

Table 11: JUNOS Software with Enhanced Services Documentation

Book	Description
JUNOS Software with Enhanced Services Design and Implementation Guide	Provides guidelines and examples for designing and implementing IP Security (IPSec) virtual private networks (VPNs), firewalls, and routing on J-series routers running JUNOS software with enhanced services.
JUNOS Software with Enhanced Services J-series Services Router Quick Start	Explains how to quickly set up a J-series router. This document contains router declarations of conformity.
JUNOS Software with Enhanced Services J-series Services Router Getting Started Guide	Provides an overview, basic instructions, and specifications for J-series Services Routers. This guide explains how to prepare a site, unpack and install the router, replace router hardware, and establish basic router connectivity. This guide contains hardware descriptions and specifications.
JUNOS Software with Enhanced Services Migration Guide	Provides instructions for migrating an SSG device running ScreenOS software or a J-series router running the JUNOS software to JUNOS software with enhanced services.
JUNOS Software with Enhanced Services Interfaces and Routing Configuration Guide	Explains how to configure J-series router interfaces for basic IP routing with standard routing protocols, ISDN service, firewall filters (access control lists), and class-of-service (CoS) traffic classification.
JUNOS Software with Enhanced Services Security Configuration Guide	Explains how to configure and manage security services such as stateful firewall policies, IPSec VPNs, firewall screens, Network Address translation (NAT) and Router interface modes, Public Key Cryptography, and Application Layer Gateways (ALGs).
JUNOS Software with Enhanced Services Administration Guide	Shows how to monitor the router and routing operations, firewall and security services, system alarms and events, and network performance. This guide also shows how to administer user authentication and access, upgrade software, and diagnose common problems.
JUNOS Software with Enhanced Services CLI Reference	Provides the complete JUNOS software with enhanced services configuration hierarchy and describes the configuration statements and operational mode commands not documented in the standard JUNOS manuals.
WXC Integrated Services Module Installation and Configuration Guide	Explains how to install and initially configure a WXC Integrated Services Module in a J-series router for application acceleration.
JUNOS Software with Enhanced Services Release Notes	Summarize new features and known problems for a particular release of JUNOS software with enhanced services on J-series routers, including J-Web interface features and problems. The release notes also contain corrections and updates to the manuals and software upgrade and downgrade instructions for JUNOS software with enhanced services.

Table 12: 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.
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.

Documentation Feedback

We encourage you to provide feedback, comments, and suggestions so that we can improve the documentation. You can send your comments to techpubs-comments@juniper.net, or fill out the documentation feedback form at http://www.juniper.net/techpubs/docbug/docbugreport.html. If you are using e-mail, be sure to include the following information with your comments:

■ Document name

■ Document part number

■ Page number

■ Software release version (not required for *Network Operations Guides [NOGs])*

Requesting Technical Support

Technical product support is available through the Juniper Networks Technical Assistance Center (JTAC). If you are a customer with an active J-Care or JNASC support contract, or are covered under warranty, and need postsales technical support, you can access our tools and resources online or open a case with JTAC.

- JTAC policies—For a complete understanding of our JTAC procedures and policies, review the JTAC User Guide located at http://www.juniper.net/customers/support/downloads/710059.pdf.

- Product warranties—For product warranty information, visit http://www.juniper.net/support/warranty/.

- JTAC Hours of Operation —The JTAC centers have resources available 24 hours a day, 7 days a week, 365 days a year.

Self-Help Online Tools and Resources

For quick and easy problem resolution, Juniper Networks has designed an online self-service portal called the Customer Support Center (CSC) that provides you with the following features:

- Find CSC offerings: http://www.juniper.net/customers/support/

- Search for known bugs: http://www2.juniper.net/kb/

- Find product documentation: http://www.juniper.net/techpubs/

- Find solutions and answer questions using our Knowledge Base: http://kb.juniper.net/

- Download the latest versions of software and review release notes: http://www.juniper.net/customers/csc/software/

- Search technical bulletins for relevant hardware and software notifications: https://www.juniper.net/alerts/

- Join and participate in the Juniper Networks Community Forum: http://www.juniper.net/company/communities/

- Open a case online in the CSC Case Manager: http://www.juniper.net/cm/

To verify service entitlement by product serial number, use our Serial Number Entitlement (SNE) Tool located at https://tools.juniper.net/SerialNumberEntitlementSearch/.

Opening a Case with JTAC

You can open a case with JTAC on the Web or by telephone.

- Use the Case Manager tool in the CSC at http://www.juniper.net/cm/ .

- Call 1-888-314-JTAC (1-888-314-5822 toll-free in the USA, Canada, and Mexico).

For international or direct-dial options in countries without toll-free numbers, visit us at http://www.juniper.net/support/requesting-support.html.

Revision History

28 April 2008—530-021924-01. Revision 2. Minor updates.

19 October 2007—530-021924-01. Revision 1.

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