

FPC Installation Instructions

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This document describes how to remove and replace a Flexible PIC Concentrator (FPC) on a Juniper Networks routing platform.

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Table of Supported FPCs by Routing Platform

FPCs are platform-specific. Table 1 on page 3 lists the FPCs that each routing platform supports. On a specific routing platform, you can install an FPC into any FPC slot regardless of the PICs it contains. You can use any combination of slots.

For a list of FPCs that are end-of-life, see the *M-series and T-series Routing Platforms End-of-Life FPC Guide*.

Table 1: Supported FPCs by Chassis

Routing Platform	Supported FPCs	Model Numbers
M40e	FPC	M40e-FPC
	Enhanced Plus FPC1	M40e-FPC1-EP
	Enhanced Plus FPC2	M40e-FPC2-EP
M120	FPC1	M120-FPC1
	FPC2	M120-FPC2
	FPC3	M120-FPC3
	Compact FPC (cFPC)	M120-cFPC-1OC192-XFP
		M120-cFPC-1XGE-XFP
M320	Enhanced II FPC1	M320-FPC1-E2
	Enhanced II FPC2	M320-FPC2-E2
	Enhanced II FPC3	M320-FPC3-E2
	Enhanced III FPC1	M320-FPC1-E3
	Enhanced III FPC2	M320-FPC2-E3
	Enhanced III FPC3	M320-FPC3-E3
T320	FPC1	T320-FPC1
	FPC2	T320-FPC2
	FPC3	T320-FPC3
	Enhanced II FPC1	T320-FPC1-E2
	Enhanced II FPC2	T320-FPC2-E2
	Enhanced II FPC3	T320-FPC3-E2

Table 1: Supported FPCs by Chassis *(continued)*

Routing Platform	Supported FPCs	Model Numbers
T640	FPC2	T640-FPC2
	FPC3	T640-FPC3
	Enhanced II FPC1	T640-FPC1-E2
	Enhanced II FPC2	T640-FPC2-E2
	Enhanced II FPC3	T640-FPC3-E2
	T640 Enhanced Scaling FPC3	T640-FPC3-ES
	T640 Enhanced Scaling FPC4 (one PIC slot)	T640-FPC4-ES
T1600	FPC2	T640-FPC2
	FPC3	T640-FPC3
	Enhanced II FPC1	T640-FPC1-E2
	Enhanced II FPC2	T640-FPC2-E2
	Enhanced II FPC3	T640-FPC3-E2
	T640 Enhanced Scaling FPC3	T640-FPC3-ES
	T640 Enhanced Scaling FPC4 (one PIC slot)	T640-FPC4-ES
	T1600 Enhanced Scaling FPC4 (two PIC slots)	T1600-FPC4-ES

FPC Description

The FPCs on a router house the Physical Interface Cards (PICs), which connect the router to network media. The main function of an FPC is to connect the PICs installed in it to the other router components.

In this manual, all types of FPCs, (including Enhanced FPCs) are referred to simply as “FPC,” except where the differences among them are discussed.

Enhanced Plus FPCs

Enhanced Plus Flexible PIC Concentrators (FPCs) are available for the M40e routing platform. An Enhanced Plus FPC has all the features of the corresponding standard (nonenhanced) FPC and provides additional SRAM memory (from 2 to 4 MB on an Enhanced Plus FPC1 and 4 to 8 MB on an Enhanced Plus FPC2) for increased scalability, more granular CoS capabilities, and enhanced VPN scaling.

Enhanced II FPCs

Enhanced II Flexible PIC Concentrators (FPCs) are available for the M320, T320, T640, and T1600 routing platforms. An Enhanced II FPC has all the features of the corresponding standard and Enhanced FPCs and provides additional DRAM memory for QoS, tricolor marking, and scaling enhancements.

Enhanced III FPCs

Enhanced III Flexible PIC Concentrators (FPCs) are available for the M320 routing platform. An Enhanced III FPC has all the features of the corresponding Enhanced II FPCs and provides additional QoS and scaling features. Enhanced III Flexible PIC Concentrators (FPCs) support any combination of PICs.

Enhanced Scaling FPCs

Enhanced Scaling Flexible PIC Concentrators (FPCs) are available for the T640 and T1600 routing platform. An Enhanced Scaling FPC has all the features of the corresponding standard and Enhanced FPCs and provides additional forwarding features and scalability improvements.

Forwarding Between FPCs and PICs

The forwarding between the FPCs and PICs varies by routing platform.

Forwarding Between FPCs and PICs on the M40e Routing Platform

An I/O Manager application-specific integrated circuit (ASIC) or ASICs on each FPC accept incoming data packets from the PICs on the FPC and divide each packet into 64-byte cells. The cells are transferred to the forwarding component. On the M40e routing platform, the forwarding component is the Switching and Forwarding Module (SFM).

An ASIC on the forwarding component distributes the cells among the memory buffers located on and shared by all installed FPCs. An I/O Manager ASIC or ASICs on the FPC reassemble the data cells into a packet and pass the packet to the appropriate PIC for transmission to the network.

Forwarding Between FPCs and PICs on the M120, M320, T320, T640 and T1600 Routing Platforms

Each Packet Forwarding Engine receives incoming packets from the PICs installed on the FPC and forwards them through the switch planes to the appropriate destination FPC and port. Each FPC contains data memory, which is managed by the Queuing and Memory Interface ASICs, and either one or two Packet Forwarding Engines.

Installing Blank FPC Panels to Ensure Proper Cooling

If an FPC slot is empty, you must install a blank FPC panel to cover it, so that cooling air can circulate properly throughout the card cage.

Hot-Inserting and Hot-Removing FPCs

FPCs are hot-insertable and hot-removable. You can remove and replace them without powering down the routing platform. When you remove an FPC, the routing platform continues to function, but the PICs installed in the FPC do not receive or transmit data.

When you install an FPC into an operating routing platform, the Routing Engine downloads the FPC software, the FPC runs its diagnostics, and the FPC enables its PICs. During this process:

- Forwarding continues uninterrupted on the M120, M320, T320, T640, and T1600 routing platforms..
- Packet forwarding halts for about 200 milliseconds (ms) on the M40e routing platform, while the Packet Forwarding Engine adjusts to the change in the amount of memory available in the pool located on and shared by all FPCs.

Tools and Parts Required

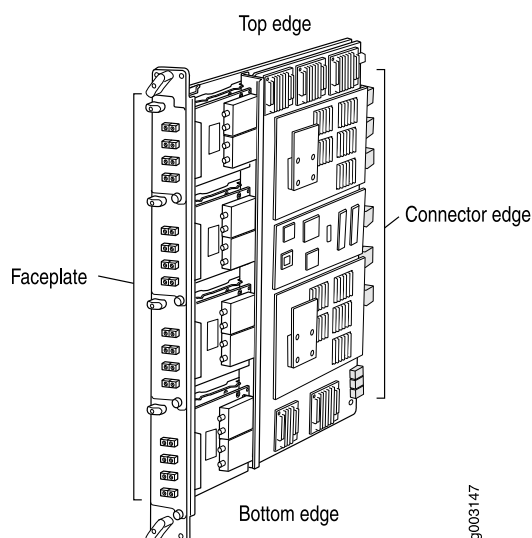
To replace an FPC, you need the following tools and parts:

- Phillips (+) screwdrivers, numbers 1 and 2
- Electrostatic bag or antistatic mat, one for each FPC removed from the chassis and PIC removed from an FPC
- Electrostatic discharge (ESD) grounding wrist strap
- Replacement component or blank panel for each component removed
- Rubber safety cap for each port on each fiber-optic PIC removed

FPC Edges

Regardless of whether you are holding an FPC vertically or horizontally, this document uses the same terms for all four edges of the FPC (see Figure 1 on page 7):

- Faceplate—Edge of the FPC that has slots into which you insert the PICs
- Connector edge—Edge opposite the faceplate; this edge has the connectors that attach to the midplane
- Top edge—Edge at the top of the FPC when it is vertical
- Bottom edge—Edge at the bottom of the FPC when it is vertical

Figure 1: FPC Edges

Handling and Storing FPCs

This section explains how to avoid damaging the FPCs that you install into routing platforms. The instructions in this section apply to all FPCs.



CAUTION: Many components on the FPC are fragile. Failure to handle FPCs as specified in this document can cause irreparable damage.

Holding an FPC



CAUTION: To prevent damage when handling or carrying FPCs, observe the following precautions.

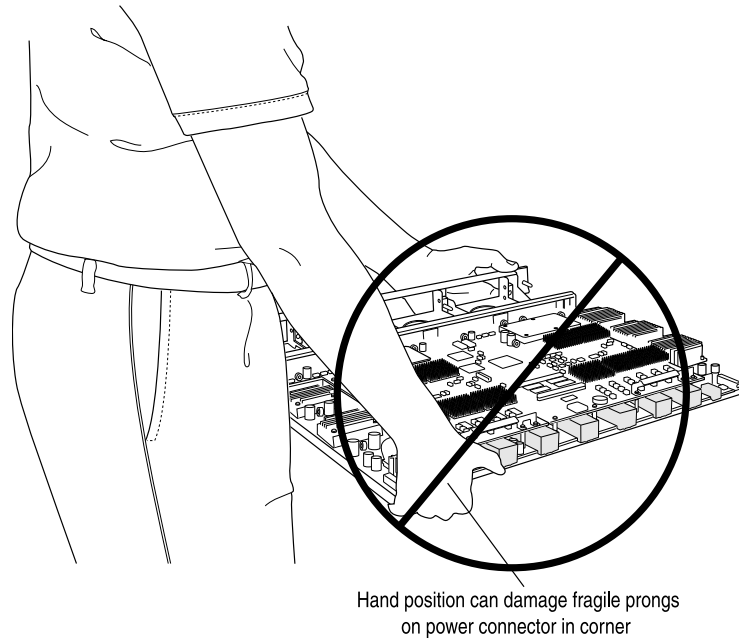


NOTE: An FPC configured with PICs installed can weigh as much as 37 lb (17 kg). Be prepared to accept the full weight of the FPC as you lift it.

As you carry the FPC, do not bump it against anything. FPC components are fragile.

Do not grasp the FPC anywhere except places that this document indicates. In particular, never grasp the connector edge, especially at the power connector in the corner where the connector and bottom edges meet (see Figure 2 on page 8).

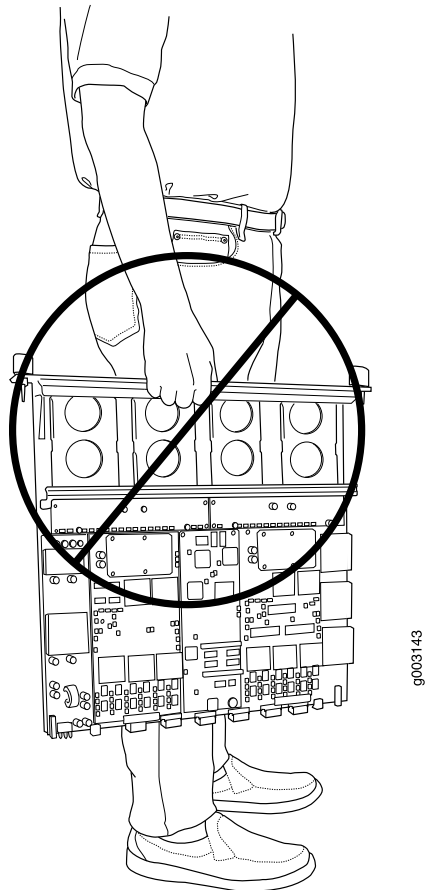
Figure 2: Do Not Grasp the Connector Edge



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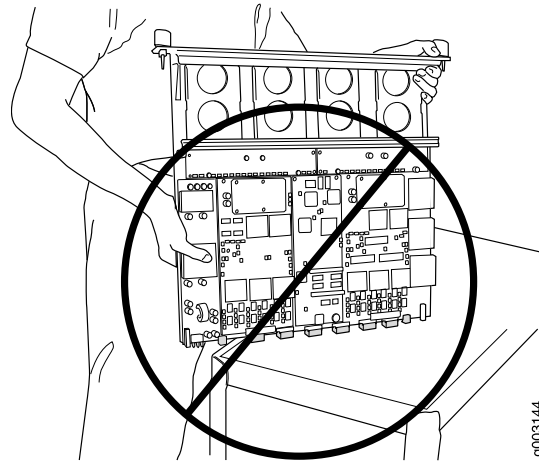
Do not carry the FPC by the faceplate with only one hand (see Figure 3 on page 9).

Figure 3: Do Not Carry an FPC with Only One Hand



Do not rest any edge of an FPC directly against a hard surface (see Figure 4 on page 10). If you must rest the FPC temporarily on an edge while changing its orientation between vertical and horizontal, use your hand as a cushion between the edge and the surface.

Figure 4: Do Not Rest the FPC on an Edge



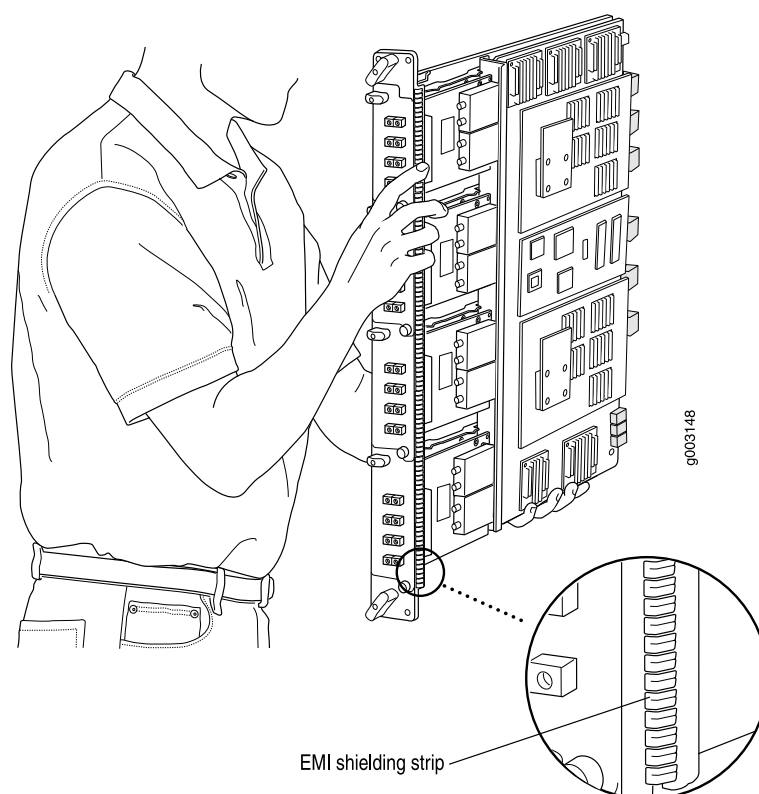
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Holding an FPC Vertically

You hold an FPC vertically or horizontally when installing it into the chassis or an equipment rack. To hold an FPC vertically (see Figure 5 on page 11):

1. Orient the FPC so that the faceplate faces you.
2. Place one hand around the FPC faceplate about a quarter of the way down from the top edge. To avoid deforming the electromagnetic interference (EMI) shielding strip, do not press hard on it.
3. Place your other hand at the bottom edge of the FPC. If the FPC has heat sinks about midway between the faceplate and connector edge, place your other hand against the heat sinks.

Figure 5: Holding an FPC Vertically



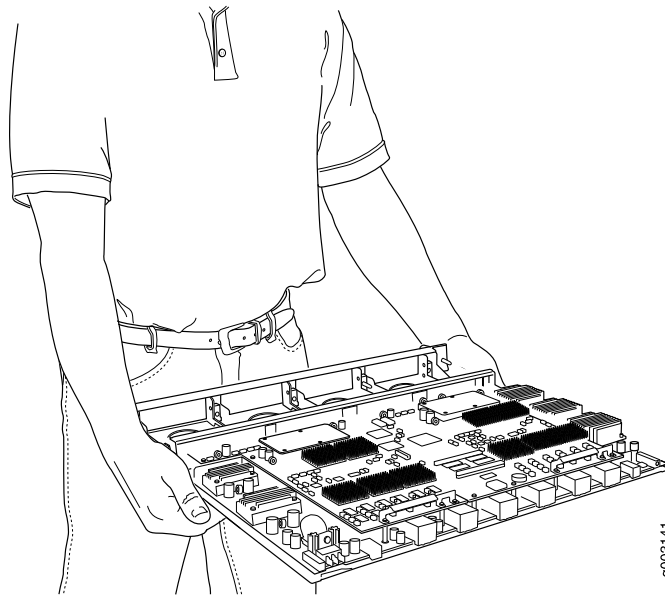
Holding an FPC Horizontally

If the FPC is horizontal before you grasp it, place your left hand around the faceplate and your right hand along the bottom edge. To hold an FPC horizontally (see Figure 6 on page 12):

1. Orient the FPC so that the faceplate faces you.
2. Grasp the top edge with your left hand and the bottom edge with your right hand. If the FPC has heat sinks about midway between the faceplate and connector edge, place your right hand against the heat sinks.

You can rest the faceplate of the FPC against your body as you carry it.

Figure 6: Holding an FPC Horizontally



Storing an FPC

When not installed in the routing platforms, FPCs must be either stored in the container in which a spare FPC is shipped or stored horizontally and component-side up on a flat, stable surface.

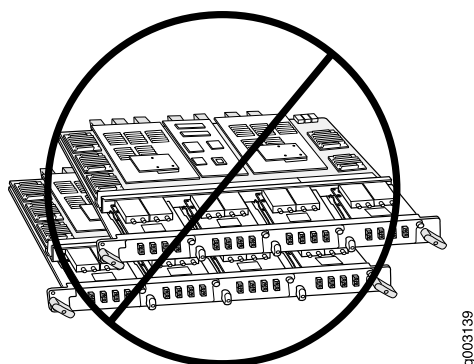
When you store an FPC on a horizontal surface or in the shipping container, always place it inside an antistatic bag. Because the FPC is heavy and because antistatic bags are fragile, inserting the FPC into the bag is easier with two people. To do this, one person holds the FPC in the horizontal position with the faceplate facing the body, and the other person slides the opening of the bag over the FPC connector edge. If you must insert the FPC into a bag by yourself, first lay the FPC horizontally on a flat, stable surface, component-side up. Orient the FPC with the faceplate facing you. Carefully insert the FPC connector edge into the opening of the bag, and pull the bag toward you to cover the FPC.



CAUTION: To prevent damage when storing FPCs, observe the following precautions:

- Never lay an FPC component-side down.
- Never stack an FPC under or on top of any other component (see Figure 7 on page 13).

Figure 7: Do Not Stack FPCs



FPCs for the M40e Router

The following sections describe the chassis, the supported FPCs, and how to replace FPCs supported by the M40e router.

- M40e Chassis Description on page 13
- FPCs Supported by the M40e Router on page 13
- Identifying M40e FPCs on page 15
- Removing an M40e FPC on page 15
- Installing an M40e FPC on page 18

M40e Chassis Description

In an M40e router, you can install up to eight FPCs vertically into the midplane from the front of the chassis. Each FPC slot is numbered FPC0 to FPC7 from left to right in the chassis.

FPCs Supported by the M40e Router

The M40e router supports the following FPCs:

- FPC—Rated at 3.2 Gbps full duplex
- Enhanced Plus FPC1—Rated at 3.2 Gbps full duplex
- Enhanced Plus FPC2—Rated at 3.2 Gbps full duplex

The M40e router supports the FPCs listed in Table 2 on page 14.



NOTE: Inserting a combination of PICs with an aggregate throughput higher than the maximum throughput per FPC is supported but constitutes oversubscription of the FPC.

Table 2: FPCs Supported by the M40e Router

FPC Type	FPC Name	FPC Model Number	Maximum Number of PICs Supported	Maximum Throughput per FPC	First JUNOS Release
1	FPC	M40e-FPC	4	3.2 Gbps	5.2
1	Enhanced Plus FPC1	M40e-FPC1-EP	4	3.2 Gbps	7.2
2	Enhanced Plus FPC2	M40e-FPC2-EP	1	3.2 Gbps	7.3

Figure 8 on page 14 shows the standard M40e-FPC.

Figure 8: M40e FPC

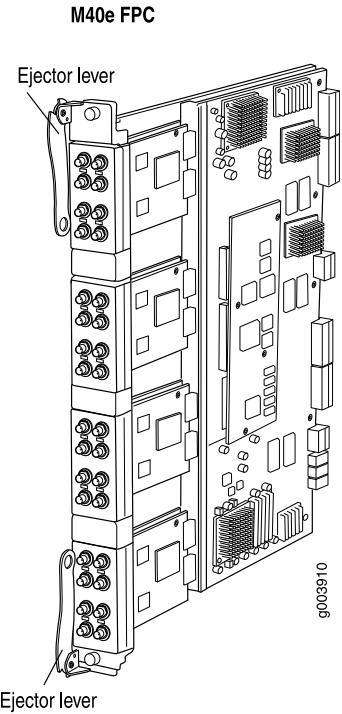
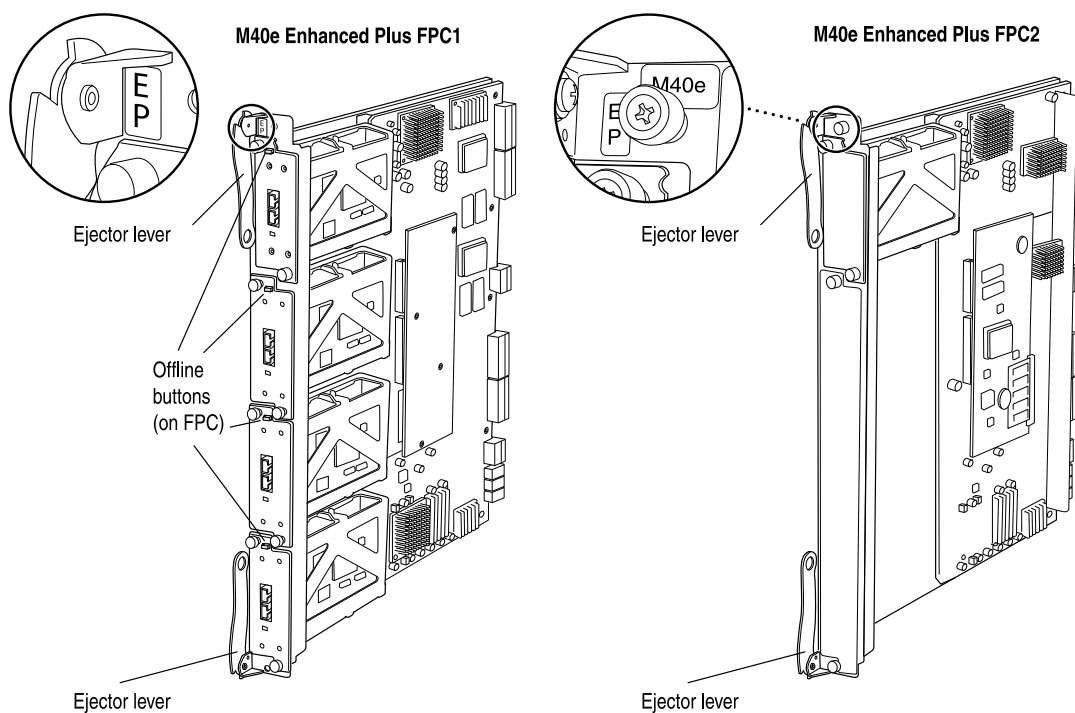


Figure 9 on page 15 shows the Enhanced Plus FPC1 and Enhanced Plus FPC2 supported by the M40e router.

Figure 9: Enhanced Plus FPCs

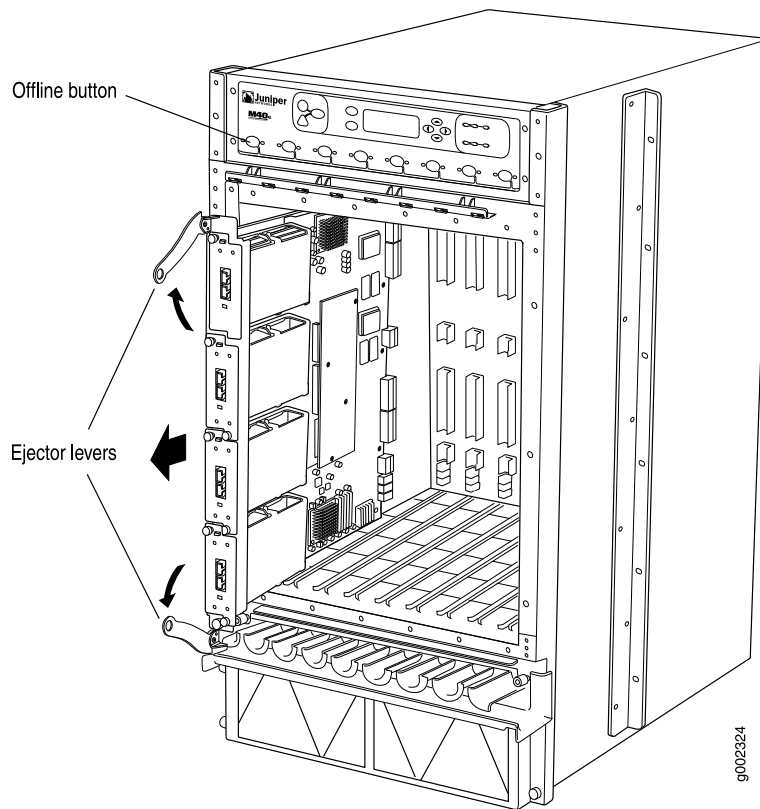
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Identifying M40e FPCs

Faceplates on Enhanced Plus FPCs supported by the M40e router are labeled with an EP sticker. For Type 1 FPCs, the offline button for each PIC is on the FPC card carrier.

Removing an M40e FPC

The FPCs on an M40e router are installed into the front of the chassis below the craft interface. Each FPC weighs up to 15 lb (6.8 kg).

Figure 10: Removing an FPC from an M40e Router

To remove an FPC, follow this procedure:

1. Place an antistatic mat on a flat, stable surface to receive the FPC. If you are removing an M40e-FPC from an M40e router, use a foam mat; if a foam mat is not available, use a standard flat antistatic mat, but use extra care when laying the M40e-FPC on it to avoid damaging the electrical components. If any of the PICs on the FPC uses fiber-optic cable, also have ready a rubber safety cap for each transceiver and cable.
2. Attach an ESD strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
3. Label the cables connected to each PIC on the FPC, so that you can reconnect each cable to the correct PIC later.
4. Take the FPC offline by pressing and holding down its offline button for about 5 seconds or until the red **FAIL** LED next to the button lights. The offline button for each FPC is on the craft interface directly above the FPC slot.
5. Disconnect the cables from the PICs on the FPC. If a PIC uses fiber-optic cable, immediately cover each transceiver and the end of each cable with a rubber safety cap. Carefully arrange the disconnected cables in the cable management system directly below the FPC card cage to prevent the cables from developing stress points.



WARNING: Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cable connected to a transceiver emit laser light that can damage your eyes.



CAUTION: Do not leave a fiber-optic transceiver uncovered except when inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.



CAUTION: Avoid bending fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

6. If you must remove or replace PICs in an M40e FPC1 or M40e FPC2, do so now, before removing the FPC from the chassis. For instructions, see the *PIC and Transceiver Installation Instructions*. If you are removing or replacing PICs in an M40e-FPC, wait until Step 12.
7. Unscrew the thumbscrews at the top and bottom of the FPC.
8. Pull the ends of the ejector levers, which are adjacent to the thumbscrews, away from the face of the FPC until they are nearly perpendicular to it (see Figure 10 on page 16).
9. Grasp the FPC with both hands and slide it about halfway out of the chassis.
10. Place one hand under the FPC to support it, and slide it completely out of the chassis.
11. Set the FPC on the antistatic foam mat that you prepared in Step 1.



CAUTION: The weight of the FPC is concentrated in the back end. Be prepared to accept the full weight—up to 15 lb (6.8 kg)—as you slide the FPC out of the chassis.

Do not hold the FPC by the ejector levers, bus bars, or edge connectors. They cannot support its weight.

To avoid damaging any components, use extra care when laying an M40e-FPC component-side up on the antistatic mat, particularly if the mat is not made of foam.

Do not stack the FPC on top of or under any other component.

12. If you are removing or replacing PICs on an M40e-FPC, see the *PIC and Transceiver Installation Instructions*.

Installing an M40e FPC

To install an FPC into an M40e router, follow this procedure:

1. Attach an ESD strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. If you are installing an M40e-FPC, you can remove or replace PICs now, before installing the M40e-FPC into the chassis. See the *PIC and Transceiver Installation Instructions*.

If you are installing an M40e FPC1 or M40e FPC2 into an M40e router, wait to remove or replace PICs until Step 7.

If any PIC uses fiber-optic cable, make sure that each transceiver is covered with a rubber safety cap.

3. Verify that the ends of the ejector levers, which are at the top and bottom of the FPC, are pushed outward and nearly perpendicular to the face of the FPC.
 4. Grasp the front of the FPC with one hand, and place the other hand under the FPC to support it.
-



CAUTION: Do not hold the FPC by the ejector levers, bus bars, or edge connectors. They cannot support its weight.

5. Align the bottom rear corner of the FPC with the guide at the bottom of the desired FPC slot. Slide the FPC all the way into the card cage until it contacts the midplane.
-



NOTE: When an M40e FPC is installed in the chassis, the lettering on the faceplates of the PICs is upside down.

6. Push the ends of the ejector levers inward until they are nearly flush with the face of the FPC (see Figure 11 on page 20).
7. If you are installing an M40e FPC1 or M40e FPC2 into an M40e router, you can remove or replace PICs at this point. For instructions, see the *PIC and Transceiver Installation Instructions*.
8. If any PICs on the FPC connect to fiber-optic cable, remove the rubber safety cap from each transceiver and cable.



WARNING: Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cable connected to a transceiver emit laser light that can damage your eyes.

9. Insert the appropriate cable into the cable connector ports on each PIC on the FPC. Secure the cables so that they do not support their own weight. Use the cable management system to place excess cable out of the way in a neatly coiled loop. Placing fasteners on a loop helps to maintain its shape.
-



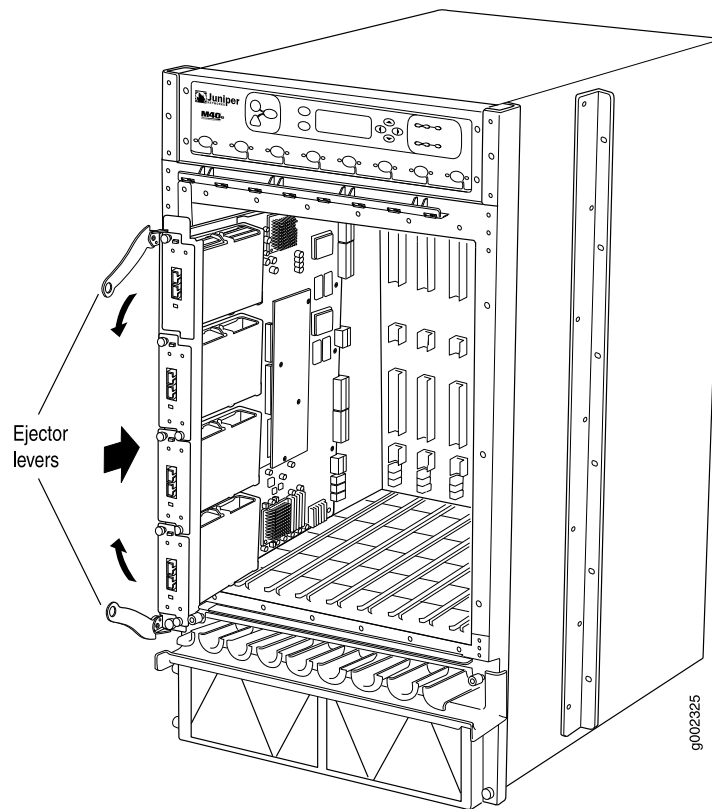
CAUTION: Do not let fiber-optic cable hang free from the connector. Do not allow fastened loops of cable to dangle, which stresses the cable at the fastening point.



CAUTION: Avoid bending fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

10. Press and hold the FPC offline button (on the craft interface above the slot that houses the FPC) to bring the FPC and PICs online. When the FPC is online, the FPC LED labeled **OK** on the craft interface lights steadily, and you can release the offline button.

Figure 11: Installing an FPC into an M40e Router



FPCs for the M120 Router

The following sections describe the chassis, the supported FPCs, and how to replace FPCs supported by the M120 router.

- M120 Chassis Description on page 21
- FPCs Supported by the M120 Router on page 21
- Identifying M120 FPCs and cFPCs on page 22
- M120 FPC Components on page 22
- Compact FPCs (cFPCs) Supported by the M120 Router on page 23
- M120 cFPC Components on page 23
- Replacing an M120 FPC on page 24

M120 Chassis Description

The router is a quarter-rack chassis that supports up to six FPCs. Four slots accept FPCs of Types 1, 2, and 3 and two slots accept Compact FPCs (cFPCs). Each FPC can be configured with a variety of network media types, altogether providing up to 130 physical interface ports per system. The cFPC slots are identical to the Type 1, 2, and 3 FPC slots, but feature a smaller form factor to provide higher density 10-Gigabit interfaces. The router height of 20.75 in. (52.71 cm) enables stacked installation of four routers in a single floor-to-ceiling rack, for increased port density per unit of floor space. In a standalone configuration, the router's maximum aggregate throughput is 120 Gbps, full duplex.

FPCs Supported by the M120 Router

The M120 router supports the following types of FPCs:

- FPC1—Rated at 4 gigabits per second (Gbps) full duplex; supports up to four PICs
- FPC2—Rated at 10 Gbps full duplex; supports up to four PICs
- FPC3—Rated at 10 Gbps full duplex; supports one PIC, including higher-speed PICs
- cFPC—Rated at 10 Gbps full duplex; supports one 10-Gbps Ethernet or one OC192 interface per cFPC

The M120 router supports the FPCs listed in Table 3 on page 21.

You can install any combination of the following FPCs in the M120 router.

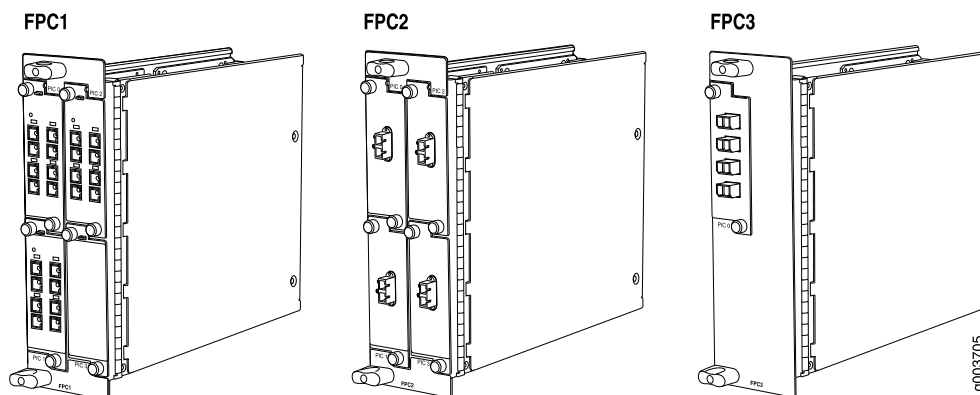
Table 3: FPCs Supported by the M120 Router

FPC Type	FPC Name	FPC Model Number	Maximum Number of PICs Supported per FPC	Maximum Throughput per FPC	First JUNOS Release
1	FPC1	M120-FPC1	4	4 Gbps	8.0R2

Table 3: FPCs Supported by the M120 Router *(continued)*

FPC Type	FPC Name	FPC Model Number	Maximum Number of PICs Supported per FPC	Maximum Throughput per FPC	First JUNOS Release
2	FPC2	M120-FPC2	4	10 Gbps	8.0R2
3	FPC3	M120-FPC3	1	10 Gbps	8.0R2

Figure 12 on page 22 shows the FPCs supported by the M120 router.

Figure 12: FPC1, FPC2, and FPC3 Supported by the M120 Router

Identifying M120 FPCs and cFPCs

Faceplates on FPCs supported by the M120 router are labeled with the FPC type (FPC1, FPC2, or FPC3). The faceplates on the cFPCs are labeled with their cFPC type, Ethernet 10GBASE XFP or OC192.

M120 FPC Components

Each FPC consists of the following components:

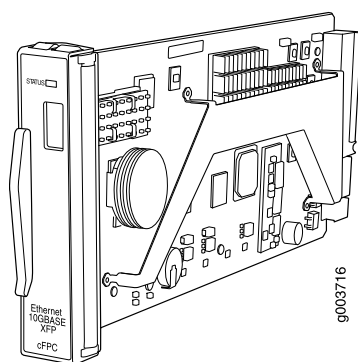
- FPC card carrier, which includes the PIC slots.
- HSL2 conversion FPGA, a bridge between the HSL2 interface and the interface required by the types of supported PICs (either BD8, BD32 or HSL1).
- HSL2 crossbar connection to the FEBs.
- PIC CPU complex.
- Physical PIC connectors.
- Midplane connectors and power circuitry.
- Processor subsystem, which includes a 667-MHz CPU, system controller, 128 MB of SDRAM, and two Fast Ethernet links to the Control Board.

- An LED, located on the craft interface above the FPC, that displays the status of the FPC.
- FPC online/offline button, located on the craft interface above the FPC.

Compact FPCs (cFPCs) Supported by the M120 Router

The M120 router supports the 10-Gigabit Ethernet cFPC and OC192 cFPC. Figure 13 on page 23 shows the Ethernet 10GBase XFP cFPC supported by the M120 router.

Figure 13: Ethernet 10GBASE XFP cFPC



M120 cFPC Components

Both cFPC types consist of the following components:

- cFPC card carrier.
- Midplane connectors and power circuitry.
- Processor subsystem, which includes a 667-MHz CPU, system controller, 128 MB of SDRAM, and two Fast Ethernet links to the Control Board.
- Crosspoint switches for redundancy.
- A metal bracket that enhances airflow and serves as a guide for removing and installing the cFPC.
- An LED located on the cFPC faceplate that displays the status of the cFPC.

The 10-Gigabit Ethernet cFPC also contains the following components:

- S2H FPGA—Bridge between HSL2 and one SPI-4.2 interface.
- 10-Gigabit Ethernet MAC interface circuitry.
- XFP optical transceiver (LAN/WAN PHY).

The OC192 cFPC also contains the following components:

- H2H FPGA—Bridge between HSLA and HSL1 interface.
- Juniper Networks D4P framer.

- XFP optical transceiver.

Replacing an M120 FPC

The FPCs are hot-insertable and hot-removable. When you remove an FPC, the router continues to function, although the PIC interfaces installed on the FPC being removed no longer function. To replace an FPC, use the following procedures:

- Removing an M120 FPC on page 24
- Installing an M120 FPC on page 26

Removing an M120 FPC

The router holds up to four FPCs, which are installed vertically in the front of the router. An empty FPC weighs 9.0 lb (4.0 kg). A fully configured FPC can weigh up to 12.3 lb (5.6 kg).

To remove an FPC, follow this procedure (see Figure 14 on page 26):

1. Have ready a replacement FPC or FPC blank panel and an antistatic mat for the FPC. Also have ready rubber safety caps for each PIC using an optical interface on the FPC that you are removing.
2. Attach an ESD wrist strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
3. Label the cables connected to each PIC on the FPC so that you can later reconnect the cables to the correct PICs.
4. Use one of the following methods to take the FPC offline:
 - Press and hold the FPC online/offline button. The green **STATUS** LED next to the button begins to blink. Hold the button down until the LED goes out. The LEDs and online/offline button for each FPC are located directly above it on the craft interface. The LEDs and online/offline button for each FPC are located directly above it on the craft interface.
 - Issue the following CLI command:

```
user@host>request chassis fpc slot slot-number offline
```

For more information about the command, see the *JUNOS System Basics and Services Command Reference*.

5. Disconnect the cables from the PICs installed in the FPC. If a PIC uses fiber-optic cable, immediately cover each transceiver and the end of each cable with a rubber safety cap. Arrange the disconnected cables in the cable management system, to prevent the cables from developing stress points.



WARNING: Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cable connected to a transceiver emit laser light that can damage your eyes.



CAUTION: Do not leave a fiber-optic transceiver uncovered except when inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

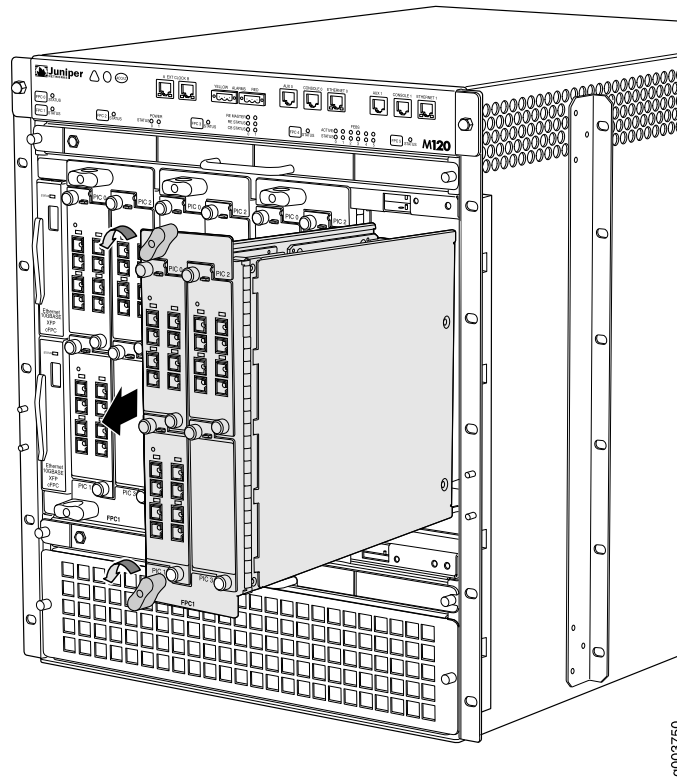


CAUTION: Avoid bending fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

6. Simultaneously turn both the ejector handles counterclockwise to unseat the FPC.
 7. Grasp the handles and slide the FPC straight out of the card cage halfway.
 8. Place one hand around the front of the FPC (the PIC housing) and the other hand under it to support it. Slide the FPC completely out of the chassis, and place it on the antistatic mat or in the electrostatic bag.
 9. If necessary, remove each installed PIC from the FPC. For information on removing a PIC, see the *M120 Internet Router Hardware Guide*.
 10. After you remove each PIC, immediately place it on an antistatic mat or in an electrostatic bag.
 11. If you are not reinstalling a FPC into the emptied FPC slot within a short time, install a blank FPC panel over the slot to maintain proper airflow in the FPC card cage.
-



CAUTION: After removing an FPC from the chassis, wait at least 30 seconds before reinserting it, removing an FPC from a different slot, or inserting an FPC into a different slot.

Figure 14: Removing an M120 FPC

Installing an M120 FPC

To install an FPC, follow this procedure (see Figure 15 on page 28):

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.
2. Place the FPC on an antistatic mat.
3. Take each PIC to be installed in the replacement FPC out of its electrostatic bag and identify the slot on the FPC where it will be connected.
4. Verify that each fiber-optic PIC has a rubber safety cap covering the PIC transceiver. If it does not, cover the transceiver with a safety cap.
5. Install each PIC into the appropriate slot on the FPC.
6. Locate the slot in the FPC card cage in which you plan to install the FPC.
7. Ensure the FPC is right-side up, with the text on the faceplate of the FPC facing upward.
8. Lift the FPC into place and carefully align first the bottom, then the top of the FPC with the guides inside the card cage.
9. Slide the FPC all the way into the card cage until you feel resistance.
10. Grasp both ejector handles and rotate them simultaneously clockwise until the FPC is fully seated.

11. If any of the PICs on the FPC connect to fiber-optic cable, remove the rubber safety cap from each transceiver and cable.
12. Insert the appropriate cable into the cable connector ports on each PIC on the FPC (See Figure 16 on page 28).
13. Secure the cables so that they are not supporting their own weight. Place excess cable out of the way in a neatly coiled loop, using the cable management system. Placing fasteners on a loop helps to maintain its shape.
14. Use one of the following methods to bring the FPC online:
 - Press and hold the FPC online/offline button until the green **STATUS** LED next to the button lights steadily, in about 5 seconds. The LEDs and online/offline button for each FPC are located directly above it on the craft interface.
 - Issue the following CLI command:

```
user@host>request chassis fpc slot slot-number online
```

For more information about the command, see the *JUNOS System Basics and Services Command Reference*.

You can also verify correct FPC and PIC functioning by issuing the **show chassis fpc** and **show chassis fpc pic-status** command.



WARNING: Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cable connected to a transceiver emit laser light that can damage your eyes.

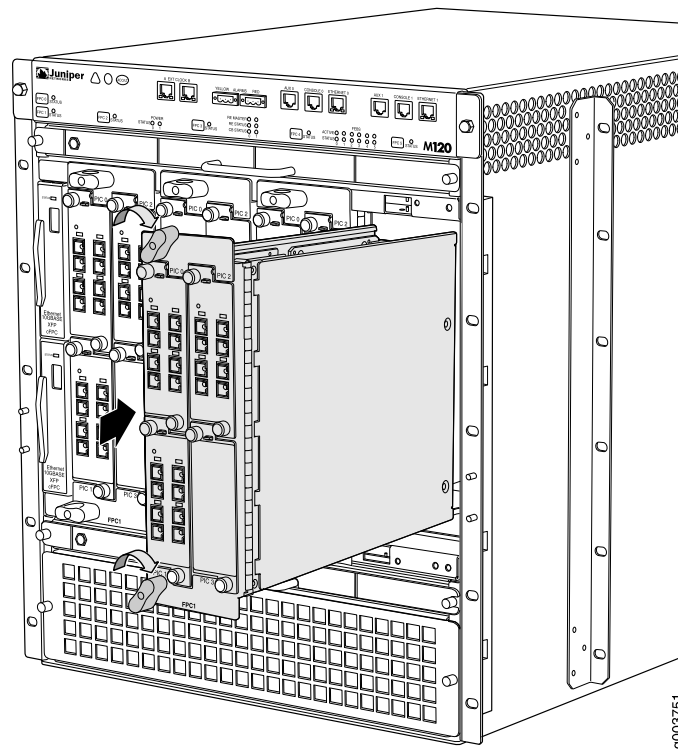


CAUTION: Do not leave a fiber-optic transceiver uncovered except when inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.



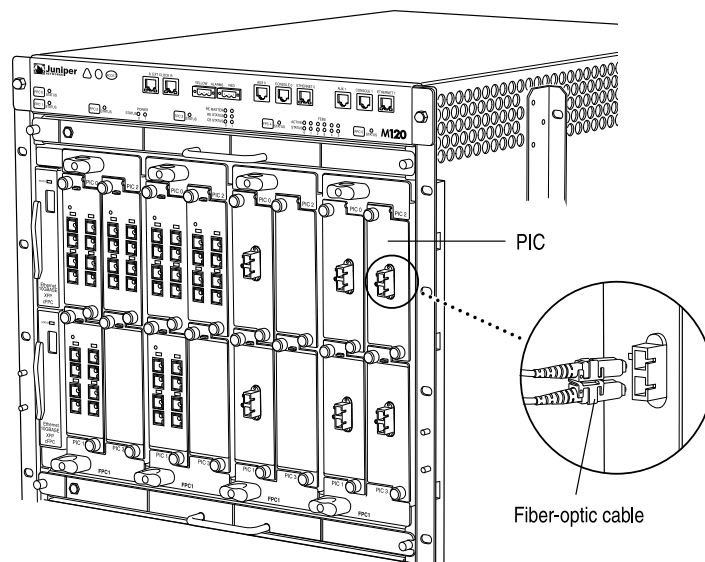
CAUTION: Avoid bending fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

Figure 15: Installing an M120 FPC



g003751

Figure 16: Connecting Fiber-Optic Cable to a PIC



g003724

FPCs for the M320, T320, T640, and T1600 Routing Platforms

The following sections describe the chassis, the supported FPCs, and how to replace FPCs for the M320, T320, T640, and T1600 routing platform.

- FPCs for the M320 Router on page 29
- FPCs for the T320 Router on page 32
- FPCs for the T640 Routing Node on page 35
- FPCs for the T1600 Routing Node on page 41
- Removing an FPC on page 49
- Installing an FPC on page 51

FPCs for the M320 Router

The following sections describe the chassis and the supported FPCs.

- M320 Chassis Description on page 29
- FPCs Supported by the M320 Router on page 29
- Identifying M320 FPCs on page 31
- M320 FPC Components on page 31

M320 Chassis Description

In the M320 router, you can install up to eight FPCs vertically in the front of the routing platform. The FPC slots are numbered **FPC0** to **FPC7** from left to right. You can install an FPC into any FPC slot on the routing platform regardless of which PICs it contains.

FPCs Supported by the M320 Router

The M320 router supports the following types of FPCs:

- Enhanced II FPC1 and Enhanced III FPC1—Rated at 4 gigabits per second (Gbps) full duplex
- Enhanced II FPC2 and Enhanced III FPC2—Rated at 16 Gbps full duplex
- Enhanced II FPC3 and Enhanced III FPC3—Rated at 20 Gbps full duplex

The M320 router supports the FPCs listed in Table 4 on page 29. You can install any combination of the following FPCs in the M320 router.

Table 4: FPCs Supported by the M320 Router

FPC Type	FPC Name	FPC Model Number	Maximum Number of PICs Supported	Maximum Throughput per FPC (Full-Duplex)	First JUNOS Release
1	Enhanced II FPC1	M320-FPC1-E2	4	4 Gbps	7.5

Table 4: FPCs Supported by the M320 Router *(continued)*

FPC Type	FPC Name	FPC Model Number	Maximum Number of PICs Supported	Maximum Throughput per FPC (Full-Duplex)	First JUNOS Release
1	Enhanced III FPC1	M320-FPC1-E3	4	4 Gbps	8.4
2	Enhanced II FPC2	M320-FPC2-E2	4	16 Gbps	7.5
2	Enhanced III FPC2	M320-FPC2-E3	4	16 Gbps	8.4
3	Enhanced II FPC3	M320-FPC3-E2	2	20 Gbps	7.5
3	Enhanced III FPC3	M320-FPC3-E3	2	20 Gbps	8.4

Figure 17 on page 30 shows the Enhanced II FPCs supported by the M320 router.

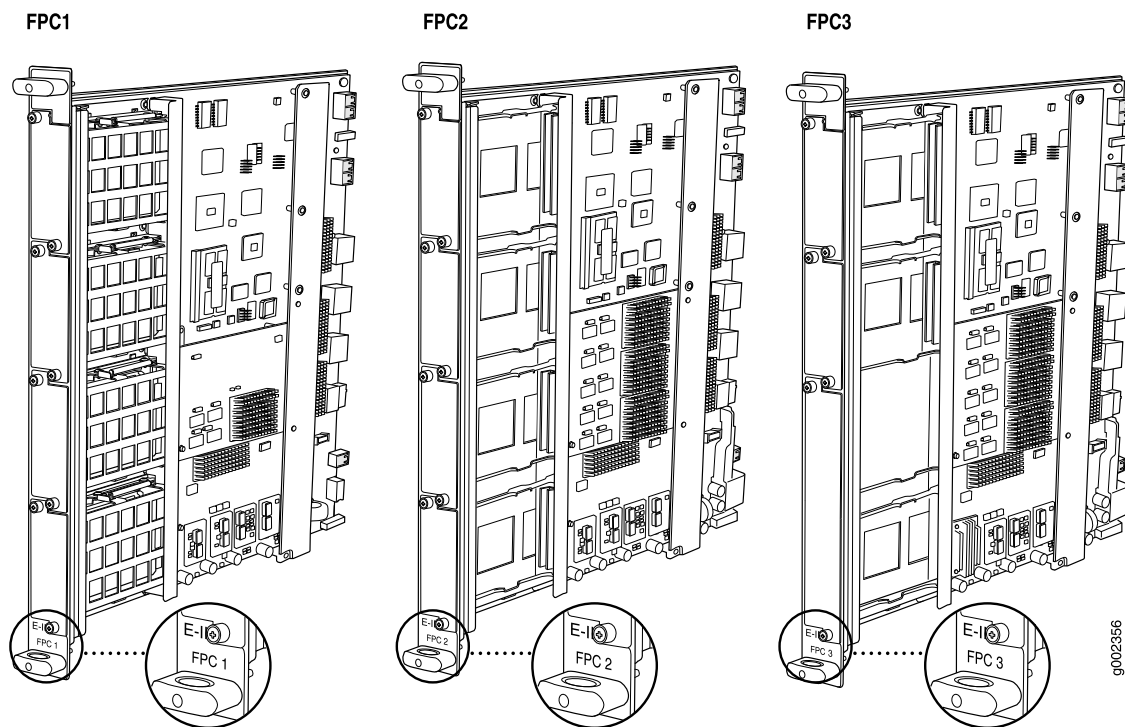
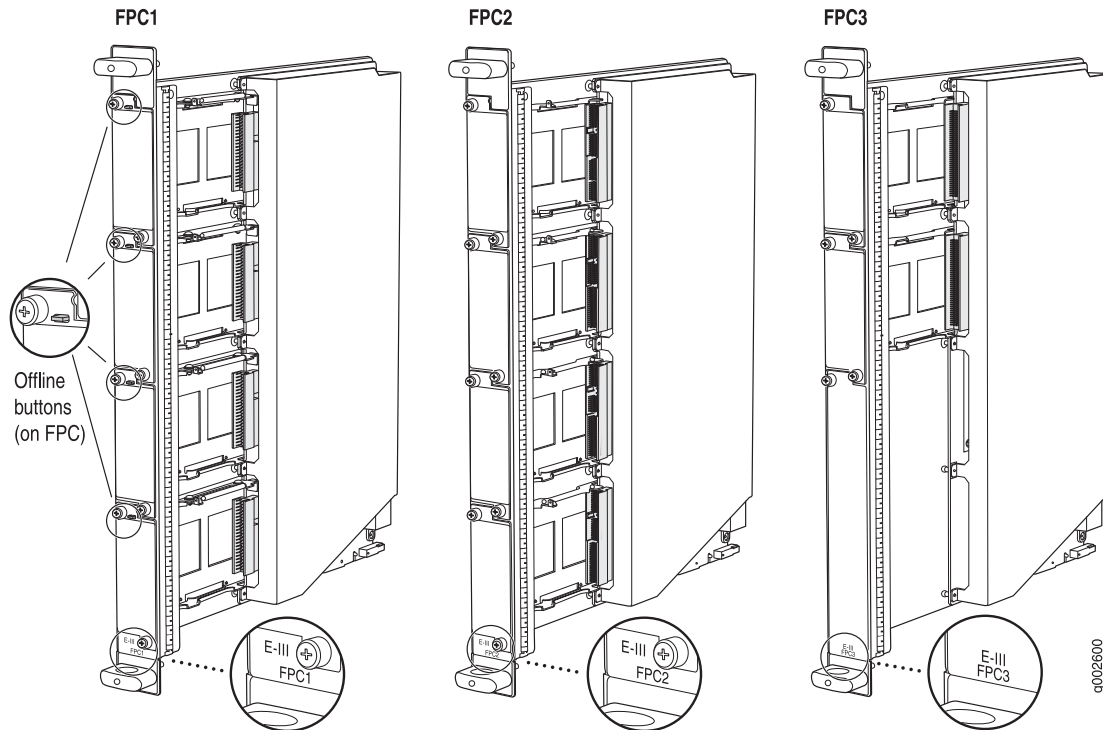
Figure 17: Enhanced II FPC1, FPC2, and FPC3 Supported by the M320 Router

Figure 18 on page 31 shows the Enhanced III FPCs supported by the M320 router.

Figure 18: Enhanced III FPC1, FPC2, and FPC3 Supported by the M320 Router



Identifying M320 FPCs

Faceplates on FPCs for the M320 router are labeled with the FPC type (FPC1, FPC2, or FPC3). The faceplates on Enhanced II FPCs are labeled E-II FPC1, E-II FPC2, or E-II FPC3. The faceplates on Enhanced III FPCs are labeled E-III FPC1, E-III FPC2, or E-III FPC3.



NOTE: You can distinguish an installed FPC1 from an FPC2 by looking at the PIC offline/online button. The button for PICs installed in an FPC1 is located slightly beneath the faceplate of the PIC. The button for PICs installed in an FPC2 is inside an opening directly on the faceplate of the PIC.

M320 FPC Components

Each M320 FPC has the following components:

- FPC card carrier, which has the PIC slots
- One Packet Forwarding Engine consisting of Layer 2/Layer 3 Packet Processing ASICs, Switch Interface ASICs, Internet Processor ASICs, and a memory subsystem (MMB), which includes the Queuing and Memory Interface ASICs
- Midplane connectors and power circuitry

- Processor subsystem (PMB), which has a 288-MHz CPU, system controller, 256 megabytes (MB) of SDRAM, and two Fast Ethernet interfaces
- Two LEDs, which are on the craft interface above the FPC, that display the status of the FPC
- FPC offline button, which is on the craft interface above the FPC

FPCs for the T320 Router

The following sections describe the chassis and the supported FPCs.

- T320 Chassis Description on page 32
- FPCs Supported by the T320 Router on page 32
- Identifying T320 FPCs on page 34
- T320 FPC Components on page 35

T320 Chassis Description

In the T320 router, you can install up to eight FPCs vertically in the front of the routing platform. The FPC slots are numbered **FPC0** to **FPC7** from left to right. You can install an FPC into any FPC slot on the routing platform regardless of which PICs it contains.

FPCs Supported by the T320 Router

The T320 router supports the following types of FPCs:

- FPC1 and Enhanced II FPC1—Rated at 2 Gbps full duplex
- FPC2 and Enhanced II FPC2—Rated at 8 Gbps full duplex
- FPC3 and Enhanced II FPC3—Rated at 20 Gbps full duplex

The T320 router supports the FPCs listed in Table 5 on page 32. You can install any combination of the following FPCs in the T320 router.

Table 5: FPCs Supported by the T320 Router

FPC Type	FPC Name	FPC Model Number	Maximum Number of PICs	Maximum Throughput (Full-Duplex)	First JUNOS Release
1	FPC1	T320-FPC1	2	2 Gbps	5.5
1	Enhanced II FPC1	T320-FPC1-E2	2	2 Gbps	7.4
2	FPC2	T320-FPC2	2	8 Gbps	5.4
2	Enhanced II FPC2	T320-FPC2-E2	2	8 Gbps	7.4
3	FPC3	T320-FPC3	2	20 Gbps	5.4
3	Enhanced II FPC3	T320-FPC3-E2	2	20 Gbps	7.4

Figure 19 on page 33 shows the standard FPCs supported by the T320 router. The enhanced FPCs look similar to the standard FPCs.

Figure 19: Standard FPC1, FPC2, and FPC3 Supported by the T320 Router

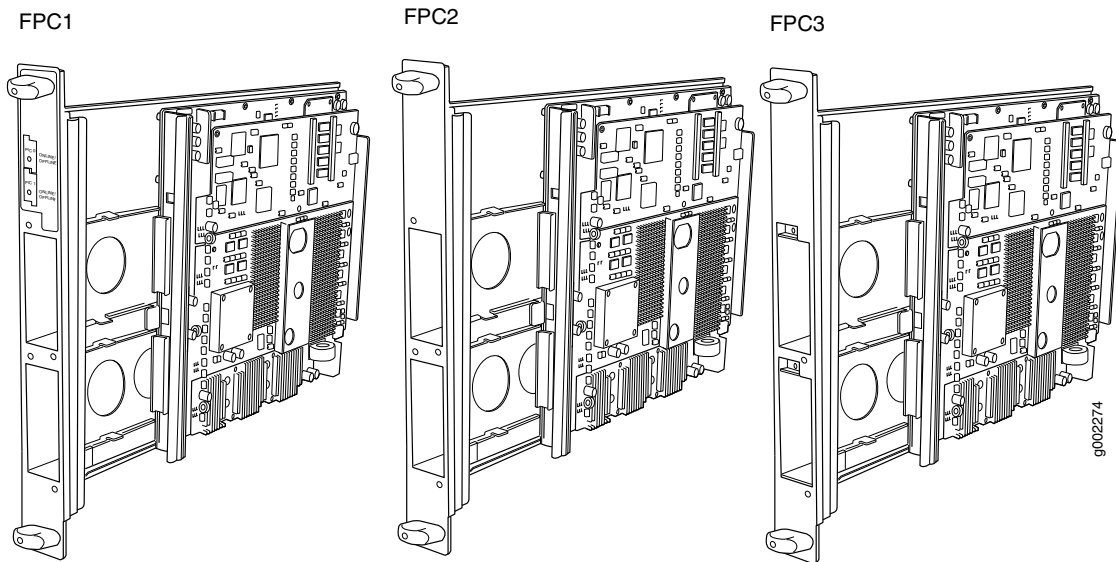
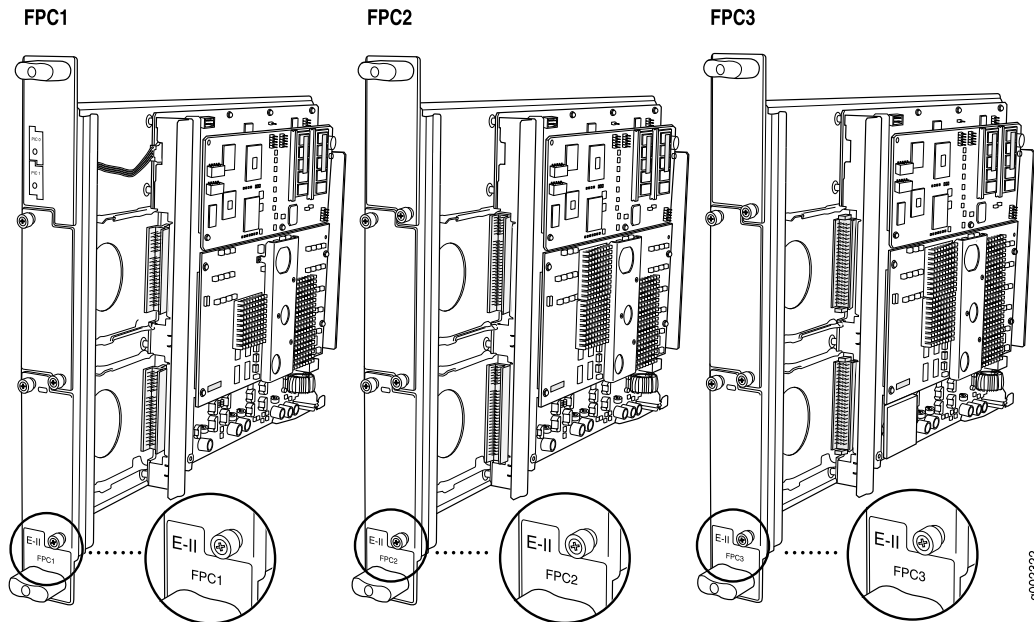


Figure 20 on page 34 shows the Enhanced II FPCs supported by the T320 router.

Figure 20: Enhanced II FPC1, FPC2, and FPC3 Supported by the T320 Router



Identifying T320 FPCs

You can tell the difference between the T320 FPC types by the different PICs installed in them:

- FPC1—A PIC that is compatible with an FPC1 does not have an offline button on its faceplate. The offline buttons for an FPC1 are on the FPC faceplate.
- FPC2—A PIC that is compatible with an FPC2 has captive screws at the top and bottom of its faceplate.
- FPC3—A PIC that is compatible with an FPC3 has a plastic ejector handle at the top of the PIC faceplate.
- Enhanced II FPC1, FPC2, and FPC3—A PIC that is compatible with an FPC3 has a plastic ejector handle at the top of the PIC faceplate.

Faceplates on Enhanced FPCs for the T320 router are labeled with the FPC type (FPC1, FPC2, or FPC3). The faceplates on Enhanced II FPCs are labeled E-II FPC1, E-II FPC2, or E-II FPC3.

T320 FPC Components

Each T320 FPC has the following components:

- FPC card carrier
- One Packet Forwarding Engine, which has Layer 2/Layer 3 Packet Processing ASICs, Switch Interface ASICs, T-series Internet Processor ASICs, and a memory subsystem (MMB), which includes the Queuing and Memory Interface ASICs
- Processor subsystem (PMB), which has a 300-MHz CPU, a system controller, 256 MB of SDRAM, and two Fast Ethernet interfaces
- FPC offline button, which is on the craft interface above the FPC
- On Type 1 FPCs, two PIC offline buttons, which are above the PIC slots on the FPC (see Figure 19 on page 33)

FPCs for the T640 Routing Node

The following sections describe the chassis and the supported FPCs.

- T640 Chassis Description on page 35
- FPCs Supported by the T640 Routing Node on page 35
- Identifying the T640 FPCs on page 40
- T640 FPC Components on page 41

T640 Chassis Description

In the T640 routing node, you can install up to eight FPCs vertically in the front of the routing platform. The FPC slots are numbered **FPC0** to **FPC7** from left to right. You can install an FPC into any FPC slot on the routing platform regardless of which PICs it contains.

FPCs Supported by the T640 Routing Node

The T640 routing node supports the following types of FPCs:

- Enhanced II FPC1—Rated at 4 Gbps full duplex
- FPC2 and Enhanced II FPC2—Rated at 16 Gbps full duplex
- FPC3, Enhanced II FPC3, and Enhanced Scaling FPC3—Rated at 40 Gbps full duplex



NOTE: If you use one or more Enhanced Scaling FPC3s in a T640 routing node that is not part of a routing matrix, each SIB in the routing node must be a SIB version B. For more information, see the *T640 Internet Routing Node Hardware Guide*.

- T640 Enhanced Scaling FPC4—Rated at 40 Gbps full duplex; supports one PIC.



NOTE: If you use one or more FPC4s in a T640 routing node that is not part of a routing matrix, each SIB in the routing node must be a SIB version B. For more information, see the *T640 Internet Routing Node Hardware Guide*.

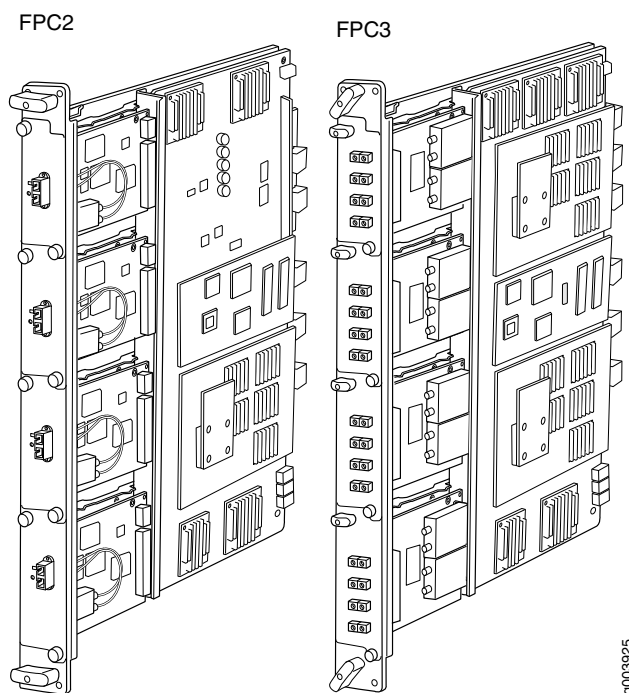
T640 routing nodes support the FPCs listed in Table 6 on page 36. You can install any combination of the following FPCs.

Table 6: FPCs Supported by the T640 Routing Node

FPC Type	FPC Name	FPC Model Number	Maximum Number of PICs	Maximum Throughput per FPC	First JUNOS Release
1	Enhanced II FPC1	T640-FPC1-E2	4	4 Gbps	7.4
2	FPC2	T640-FPC2	4	16 Gbps	5.3
2	Enhanced II FPC2	T640-FPC2-E2	4	16 Gbps	7.4
3	FPC3	T640-FPC3	4	40 Gbps	5.3
3	Enhanced II FPC3	T640-FPC3-E2	4	40 Gbps	7.4
3	Enhanced Scaling FPC3	T640-FPC3-ES	4	40 Gbps	9.0
4	Enhanced Scaling FPC4	T640-FPC4-ES	1	40 Gbps	7.5

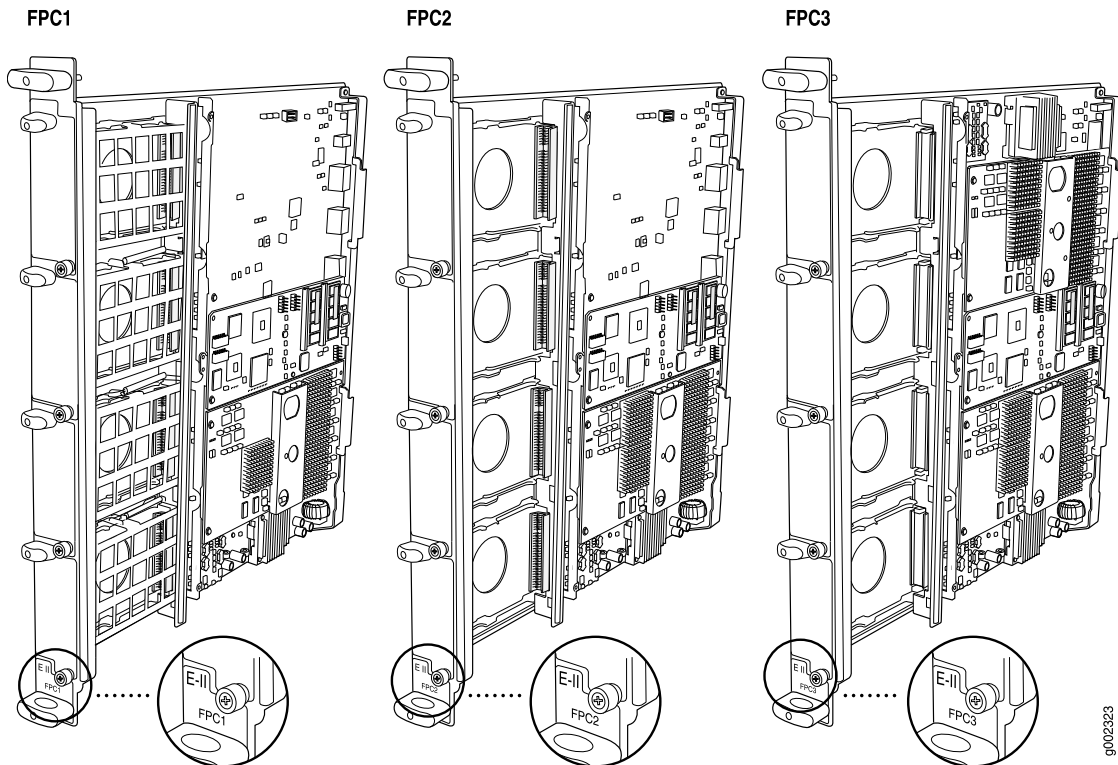
The T640 routing node supports the standard FPC2 and FPC3 shown in Figure 21 on page 37.

Figure 21: Standard FPC2 and FPC3 Supported by the T640 Routing Node



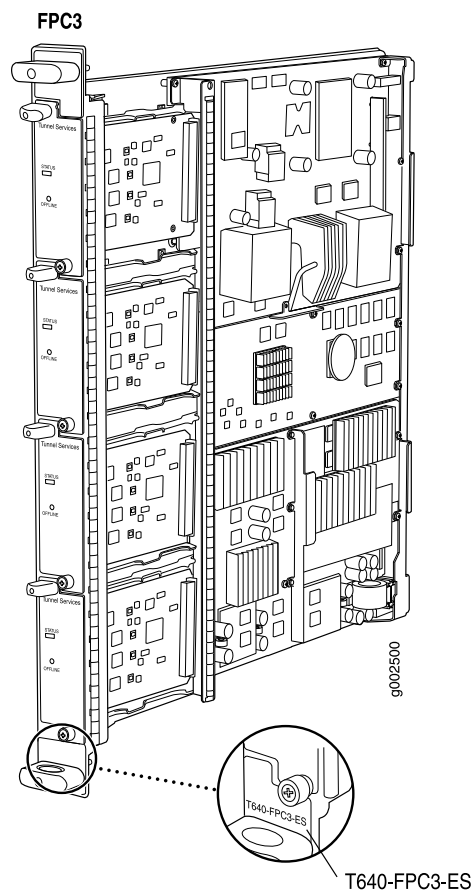
The T640 routing node supports the Enhanced II FPC1, FPC2 and FPC3 shown in Figure 22 on page 38.

Figure 22: Enhanced II FPC1, FPC2 and FPC3 Supported by the T640 Routing Node



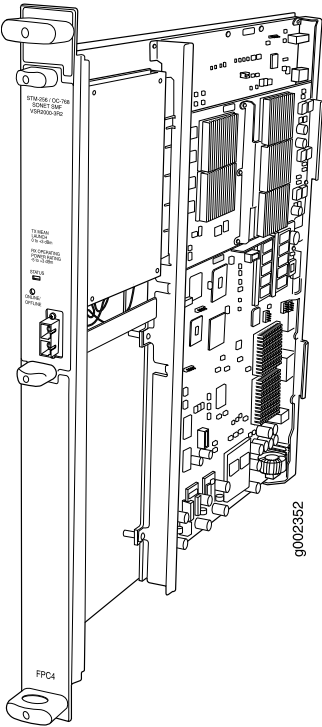
The T640 routing node supports the Enhanced Scaling FPC3 shown in Figure 23 on page 39.

Figure 23: Enhanced Scaling FPC3 Supported by the T640 Routing Node



The T640 routing node supports the Enhanced Scaling FPC4 shown in Figure 24 on page 40.

Figure 24: Enhanced Scaling FPC4 Supported by the T640 Routing Node



Identifying the T640 FPCs

Check the label on the faceplate to identify the type of FPC. For FPCs without a label on the faceplate, check the location of a PIC's offline button and how the PIC is secured to the FPC. See Table 7 on page 40.

Table 7: Identifying the FPCs Supported by the T640 Routing Node

FPC	Label on the FPC Faceplate	Location of PIC Offline Button	Method of Securing the PIC to the FPC
Enhanced II FPC1	E-II FPC1	Slightly beneath the faceplate of the PIC	Two captive screws
FPC2	None	Inside an opening directly on the faceplate of each PIC	Two captive screws
Enhanced II FPC2	E-II FPC2	Inside an opening directly on the faceplate of each PIC	Two captive screws
FPC3	None	Inside an opening directly on the faceplate of each PIC	Plastic ejector handle at the top of the PIC faceplate; captive screw at the bottom of the PIC faceplate

Table 7: Identifying the FPCs Supported by the T640 Routing Node *(continued)*

FPC	Label on the FPC Faceplate	Location of PIC Offline Button	Method of Securing the PIC to the FPC
Enhanced II FPC3	E-II FPC3	Inside an opening directly on the faceplate of each PIC	Plastic ejector handle at the top of the PIC faceplate; captive screw at the bottom of the PIC faceplate
Enhanced Scaling FPC3	T640-FPC3-ES	Inside an opening directly on the faceplate of each PIC	Two plastic ejector handles at the top and bottom of the PIC faceplate
T640 Enhanced Scaling FPC4	FPC4	Inside an opening directly on the faceplate of each PIC	Two plastic ejector handles at the top and bottom of the PIC faceplate

T640 FPC Components

Each FPC consists of the following components:

- FPC card carrier.
- One or two Packet Forwarding Engines, consisting of Layer 2/Layer 3 Packet Processing ASICs, Switch Interface ASICs, T-series Internet Processor ASICs, and a Memory Mezzanine Board (MMB) which includes the Queuing and Memory Interface ASICs. Each Type 1, Type 2, and Type 4 FPC has one Packet Forwarding Engine, and each Type 3 FPC has two Packet Forwarding Engines.
- Processor Mezzanine Board (PMB), which includes a 300-MHz CPU, system controller, 256 MB of SDRAM, and two Fast Ethernet interfaces.
- Two LEDs, located on the craft interface above the FPC, that display the status of the FPC.
- FPC online/offline button, located on the craft interface above the FPC.

FPCs for the T1600 Routing Node

The following sections describe the chassis and the supported FPCs.

- T1600 Chassis Description on page 41
- FPCs Supported by the T1600 Routing Node on page 42
- Identifying the T1600 FPCs on page 47
- T1600 FPC Components on page 48

T1600 Chassis Description

In the T1600 routing node, you can install up to eight FPCs vertically in the front of the routing platform. The FPC slots are numbered **FPC0** to **FPC7** from left to right. You can install an FPC into any FPC slot on the routing platform regardless of which PICs it contains.

FPCs Supported by the T1600 Routing Node

The T1600 routing node supports the following FPCs:

- Enhanced II FPC1—Rated at 4 Gbps full duplex
- FPC2 and Enhanced II FPC2—Rated at 16 Gbps full duplex
- FPC3 and Enhanced II FPC3, and EnhancedScaling FPC3—Rated at 40 Gbps full duplex
- T640 Enhanced Scaling FPC4—Rated at 40 Gbps full duplex
- T1600 Enhanced Scaling FPC4—Rated at 100 Gbps full duplex

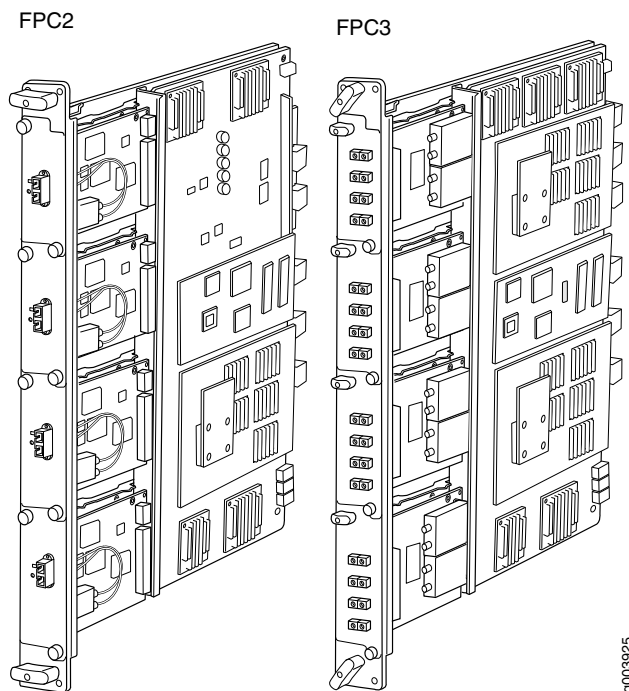
T1600 routing nodes support the FPCs listed in Table 8 on page 42. You can install any combination of the following FPCs.

Table 8: FPCs Supported by the T1600 Routing Node

FPC Type	FPC Name	FPC Model Number	Maximum Number of PICs	Maximum Throughput per FPC	First JUNOS Release
1	Enhanced II FPC1	T640-FPC1-E2	4	4 Gbps	7.4
2	FPC2	T640-FPC2	4	16 Gbps	5.3
2	Enhanced II FPC2	T640-FPC2-E2	4	16 Gbps	7.4
3	FPC3	T640-FPC3	4	40 Gbps	5.3
3	Enhanced Scaling FPC3	T640-FPC3-ES	4	40 Gbps	9.0
4	T640 Enhanced Scaling FPC4	T640-FPC4-ES	1	40 Gbps	7.5
4	T1600 Enhanced Scaling FPC4	T1600-FPC4-ES	2	100 Gbps	8.5

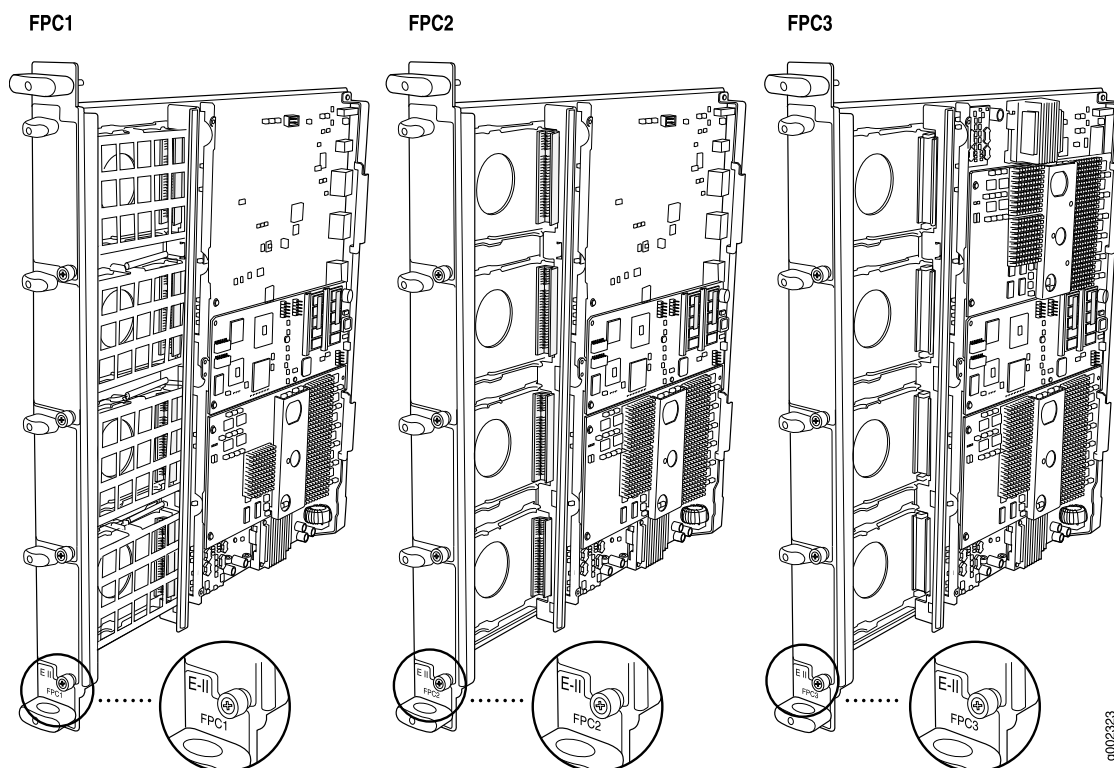
The T1600 routing node supports the standard FPC2 and FPC3 shown in Figure 25 on page 43.

Figure 25: Standard FPC2 and FPC3 Supported by the T1600 Routing Node



The T1600 routing node supports the Enhanced II FPC1, FPC2, and FPC3 shown in Figure 26 on page 44.

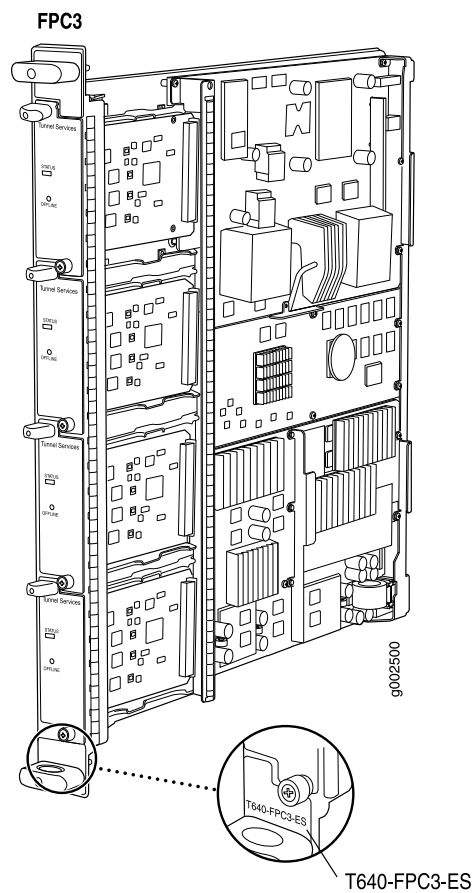
Figure 26: Enhanced II FPC1, FPC2, and FPC3 Supported by the T1600 Routing Node



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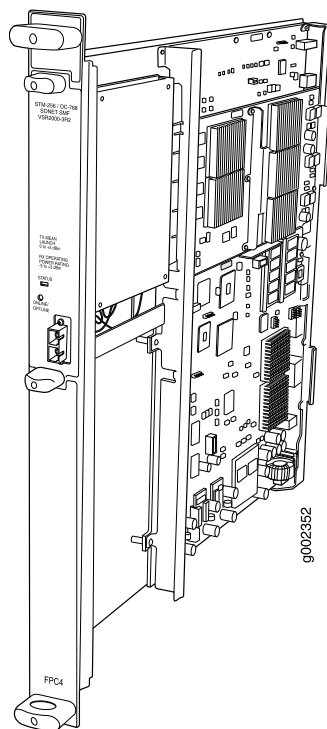
The T1600 routing node supports the Enhanced Scaling FPC3 shown in Figure 27 on page 45.

Figure 27: Enhanced Scaling FPC3 Supported by the T1600 Routing Node



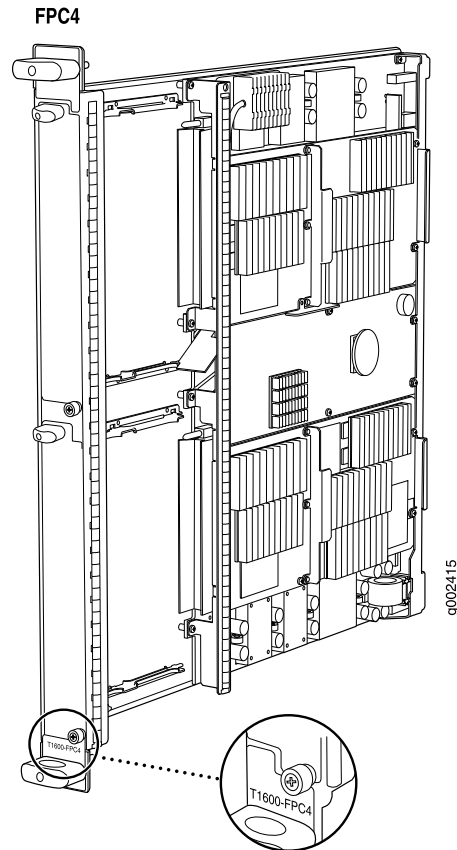
The T1600 routing node supports the T640 Enhanced Scaling FPC4 shown in Figure 28 on page 46.

Figure 28: T640 Enhanced Scaling FPC4 Supported by the T1600 Routing Node



The T1600 routing node supports the T1600 Enhanced Scaling FPC4 shown in Figure 29 on page 47.

Figure 29: T1600 Enhanced Scaling FPC4 Supported by the T1600 Routing Node



Identifying the T1600 FPCs

Check the label on the faceplate to identify the type of FPC. For FPCs without a label on the faceplate, check the location of a PIC's offline button and how the PIC is secured to the FPC. See Table 9 on page 47.

Table 9: Identifying the FPCs Supported by the T1600 Routing Node

FPC	Label on the FPC Faceplate	Location of PIC Offline Button	Method of Securing the PIC to the FPC
Enhanced II FPC1	E-II FPC1	Slightly beneath the faceplate of the PIC	Two captive screws
FPC2	None	Inside an opening directly on the faceplate of each PIC	Two captive screws
Enhanced II FPC2	E-II FPC2	Inside an opening directly on the faceplate of each PIC	Two captive screws

Table 9: Identifying the FPCs Supported by the T1600 Routing Node *(continued)*

FPC	Label on the FPC Faceplate	Location of PIC Offline Button	Method of Securing the PIC to the FPC
FPC3	None	Inside an opening directly on the faceplate of each PIC	Plastic ejector handle at the top of the PIC faceplate; captive screw at the bottom of the PIC faceplate
Enhanced Scaling FPC3	T640-FPC3-ES	Inside an opening directly on the faceplate of each PIC	Two plastic ejector handles at the top and bottom of the PIC faceplate
T640 Enhanced Scaling FPC4	FPC4	Inside an opening directly on the faceplate of each PIC	Two plastic ejector handles at the top and bottom of the PIC faceplate
T1600 Enhanced Scaling FPC4	T1600-FPC4	Inside an opening directly on the faceplate of each PIC	Two plastic ejector handles at the top and bottom of the PIC faceplate

T1600 FPC Components

Each FPC consists of the following components:

- FPC card carrier.
- One or two Packet Forwarding Engines, consisting of Layer 2/Layer 3 Packet Processing ASICs, Switch Interface ASICs, T-series Internet Processor ASICs, and a Memory Mezzanine Board (MMB) which includes the Queuing and Memory Interface ASICs.
 - Each Type 1 FPC has one Packet Forwarding Engine.
 - Each Type 2 FPC has one Packet Forwarding Engine.
 - Each Type 3 FPC has two Packet Forwarding Engines.
 - Each T640-FPC4-ES has one Packet Forwarding Engine.
 - Each T1600-FPC4-ES has two Packet Forwarding Engines.
- Processor Mezzanine Board (PMB), which includes a 300-MHz CPU, system controller, 256 MB of SDRAM, and two Fast Ethernet interfaces.
- Two LEDs, located on the craft interface above the FPC, that display the status of the FPC.
- FPC online/offline button, located on the craft interface above the FPC.

Removing an FPC

Each M320, T320, T640, or T1600 routing platform holds up to eight FPCs, which you install vertically into the front of the routing platform.

To remove an FPC, follow this procedure:

1. Have ready a replacement FPC or FPC blank panel and an antistatic mat for the FPC. Also have ready rubber safety caps for each PIC that uses an optical interface on the FPC that you are removing.
2. Attach an ESD wrist strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
3. Label the cables connected to each PIC on the FPC, so that you can reconnect each cable to the correct PIC later.
4. Use one of the following methods to take the FPC offline:
 - Press and hold the FPC offline button, which is directly above the FPC. The green **OK** LED next to the button begins to blink. Hold the button down until the LED goes out (about 5 seconds).
 - Issue the following CLI command:


```
user@host> request chassis fpc slot slot-number offline
```
5. Remove the cable connectors plugged into each PIC on the FPC. If a PIC uses fiber-optic cable, immediately cover each transceiver and the end of each cable with a rubber safety cap. Carefully arrange the disconnected cables in the cable management system to prevent the cables from developing stress points.



CAUTION: Do not leave a fiber-optic transceiver uncovered except when inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.



WARNING: Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cable connected to a transceiver emit laser light that can damage your eyes.

6. Carefully drape each disconnected cable over the bobbins on the cable management system below the FPC card cage to prevent the cables from developing stress points.
-



CAUTION: Avoid bending fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

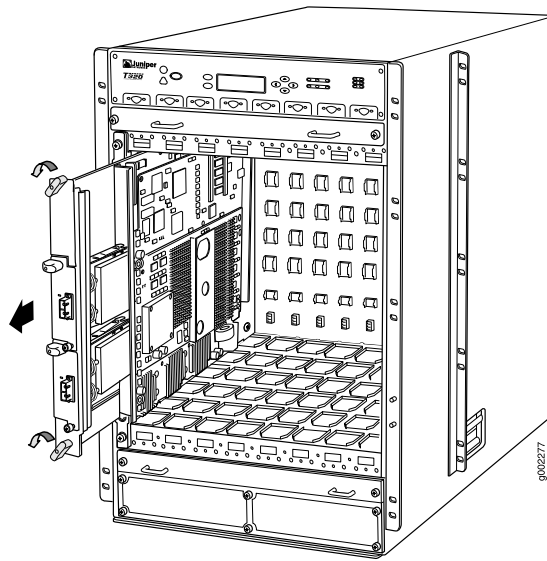
7. Simultaneously turn both ejector handles counterclockwise to unseat the FPC.



CAUTION: When the FPC is out of the chassis, do not hold it by the ejector handles or edge connectors. They cannot support its weight.

8. Grasp the handles, and slide the FPC straight out of the card cage halfway. Figure 30 on page 50 shows how to pull an FPC out of a T320 router. The procedure is the same for the M320, T640, or T1600 routing platforms.

Figure 30: Removing an FPC from a T320 Router



CAUTION: The weight of the FPC is concentrated in the back end.

Before you remove an FPC, be prepared to support its weight as you slide the FPC out of the chassis.

- An empty M320 FPC1 or FPC2 weighs 15 lb (6.8 kg), and an empty M320 FPC3 weighs 16 lb (7.3 kg). A fully configured M320 FPC can weigh up to 29 lb (13.2 kg).
 - An empty T320 FPC1 or FPC2 weighs 14.3 lb (6.5 kg), and an empty T320 FPC3 weighs 14.8 lb (6.7 kg). A fully configured T320 FPC can weigh up to 19 lb (8.6 kg).
 - An empty T640 FPC can weigh up to 25 lb (11.3 kg), and a fully configured T640 FPC can weigh up to 31.7 lb (14.4 kg).
 - An empty T1600 FPC can weigh up to 25 lb (11.3 kg), and a fully configured T1600 FPC can weigh up to 37 lb (14.5 kg).
-

9. Place one hand around the front of the FPC (the PIC housing) and the other hand under it to support it. Slide the FPC completely out of the chassis, and place it on the antistatic mat or in the electrostatic bag.



CAUTION: Do not stack FPCs on one another after removal. Place each one individually into an electrostatic bag or on its own antistatic mat on a flat, stable surface.

10. If necessary, remove each additional installed PIC from the FPC.
11. After you remove each PIC, immediately place it on an antistatic mat or in an electrostatic bag.
12. If you are not replacing the FPC now, install a blank panel over the slot to maintain proper airflow in the FPC card cage.



CAUTION: Do not operate the routing platform with any of the FPC slots empty. When you remove an FPC, immediately install a replacement FPC or FPC blank panel to prevent overheating of routing platform components and to ensure compliance with electromagnetic radiation requirements (prevent radio interference).



CAUTION: After removing an FPC from the chassis, wait at least 30 seconds before reinserting it, removing an FPC from a different slot, or inserting an FPC into a different slot.

Installing an FPC

To install a replacement FPC, follow this procedure:

1. Attach an ESD wrist strap to your bare wrist and connect the strap to one of the ESD points on the chassis.
2. Place the replacement FPC on an antistatic mat.
3. You must install or remove PICs before installing the FPC into the chassis. See the *PIC and Transceiver Installation Instructions*. If any PICs use fiber-optic cable, make sure that each transceiver is covered with a rubber safety cap.



WARNING: Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cable connected to a transceiver emit laser light that can damage your eyes.

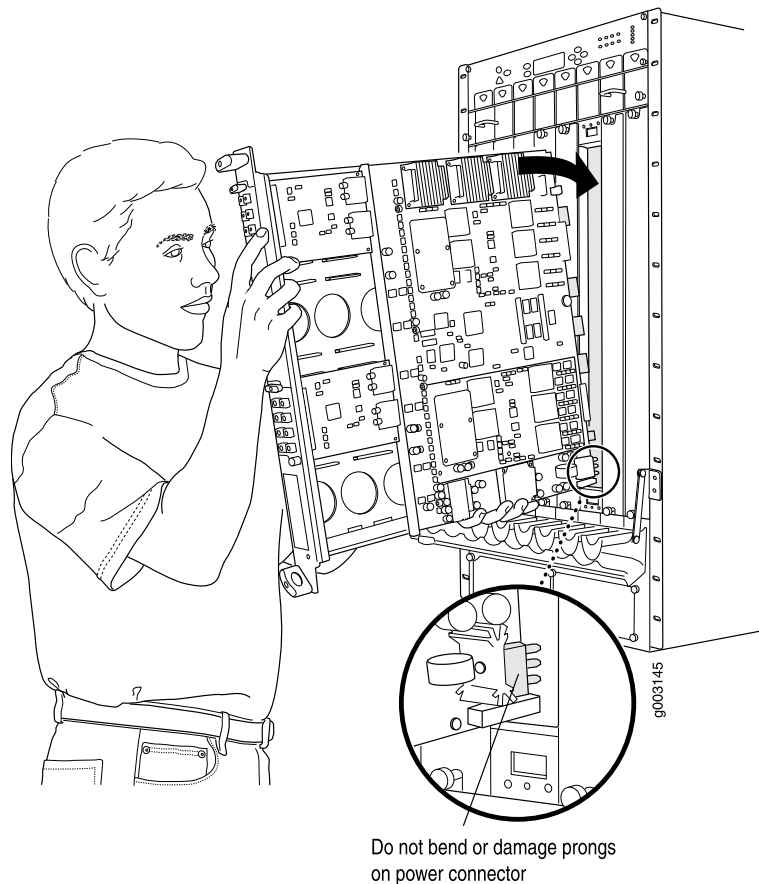
4. Grasp the front of the FPC with both hands. Orient the FPC vertically with the component side facing to the right. Be sure the FPC is right-side up.
5. Tilt the top of the FPC toward you slightly.

6. Carefully align the connector edge of the FPC with an empty slot in the chassis.
7. Gently rest the bottom edge of the FPC on the bottom edge of the slot opening. Do not rest the power connector on the slot.

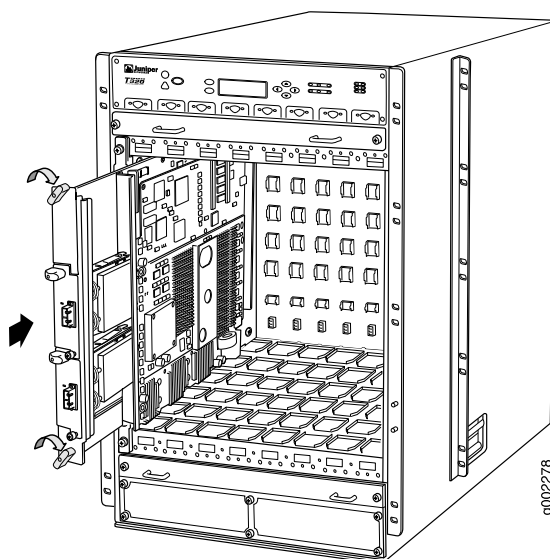


CAUTION: The FPC power connector is in the corner where the bottom and connector edges meet. If a power connector prong becomes bent, it no longer aligns with the female connector on the midplane, and the FPC no longer functions. Do not bend or otherwise damage the power connector prongs (see Figure 31 on page 52).

Figure 31: Avoiding Damage to Prongs on Power Connector



8. Tilt the top of the FPC toward the chassis until the FPC is completely vertical.
9. Slowly slide the FPC all the way into the card cage until you feel resistance. Figure 32 on page 53 shows how to slide an FPC into a T320 router. The procedure is the same for the M320, T640, and T1600 routing platform.

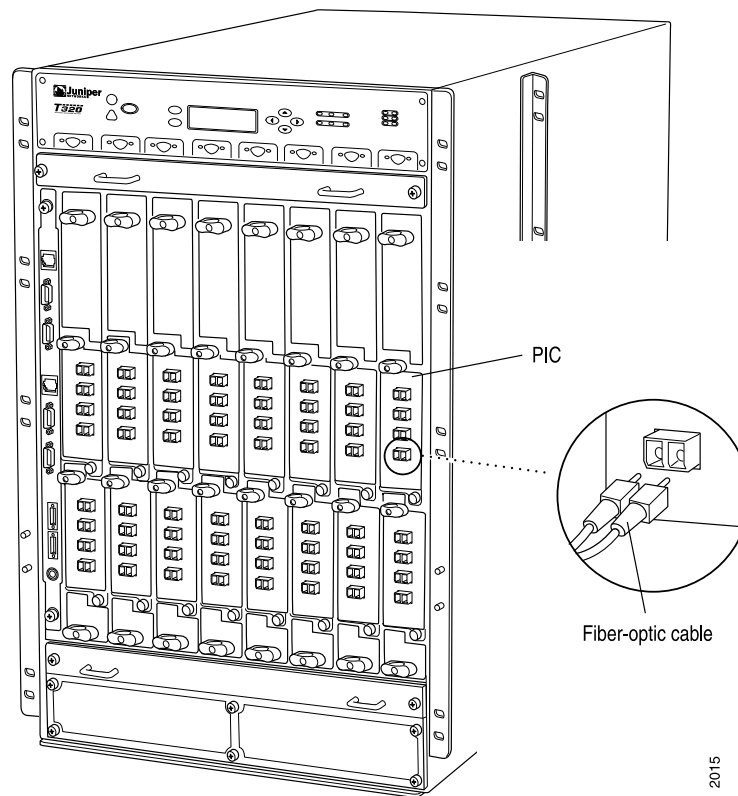
Figure 32: Installing a Replacement FPC in a T320 Router

10. Align the ejector handles on the FPC faceplate in a position close to horizontal.



CAUTION: When the FPC is out of the chassis, do not hold it by the ejector handles or edge connectors. They cannot support its weight.

11. Simultaneously turn both ejector handles clockwise until you cannot turn them farther.
12. Remove the rubber safety cap from each fiber-optic PIC transceiver.
13. Insert the appropriate cable into the ports on each PIC transceiver on the FPC (see Figure 33 on page 54).

Figure 33: Connecting Fiber-Optic Cable to a PIC

14. Secure the cables so that they do not support their own weight. Use the cable management system to place excess cable out of the way in a neatly coiled loop,



CAUTION: Do not let fiber-optic cable hang free from the connector. Do not allow fastened loops of cable to dangle, which stresses the cable at the fastening point.

15. Press and hold the FPC offline button until the green **OK** LED next to the button lights steadily in about 5 seconds. The LED and offline button for each FPC are directly above the FPC on the craft interface.

Verifying That an FPC Is Installed Correctly

When you bring the FPC online in an operational routing platform, the Routing Engine downloads the FPC software, and the FPC runs its diagnostics. The green **OK** LED that corresponds to the FPC blinks as the FPC starts up. The **OK** LED for each FPC is above the FPC.

When the FPC is online, the **OK** LED lights steadily. If the red **FAIL** LED lights steadily instead, remove and install the FPC again using the instructions in this document. If the red **FAIL** LED still lights steadily, the FPC is not working properly. Contact your customer support representative.

To check the status of the FPCs and PICs with the command-line interface (CLI), use the following command:

```
user@host> show chassis fpc pic-status
```

For more information about using the CLI to get information about the FPCs and PICs, see the *JUNOS System Basics and Services Command Reference*.

Configuring PIC Software after FPC Installation

If you have installed an FPC that houses one or more PICs, the PICs function only after you add the necessary statements for them to the router configuration. For instructions, see the *JUNOS Network Interfaces Configuration Guide*. If you have installed a blank FPC panel or a blank PIC, you do not need to modify the configuration of the router. The router automatically discovers that the interfaces in an FPC slot or PIC location are nonoperational and does not attempt to initialize them.

Safety Guidelines and Warnings

When removing and installing PICs that use fiber-optic cable on any routing platform, note the following guidelines:



WARNING: Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cable connected to a transceiver emit laser light that can damage your eyes.



CAUTION: Do not leave a fiber-optic transceiver uncovered except when inserting or removing cable. The safety cap keeps the port clean and prevents accidental exposure to laser light.

When connecting and disconnecting cable at the ports on the PIC faceplate on any routing platform, note the following guidelines:



CAUTION: Do not let fiber-optic cable hang free from the connector. Do not allow fastened loops of cable to dangle, which stresses the cable at the fastening point.



CAUTION: Secure cables in the cable management system so that they do not support their own weight. Use the cable management system to place excess cable out of the way in a neatly coiled loop. Placing fasteners on a loop helps to maintain its shape.



CAUTION: Avoid bending fiber-optic cable beyond its minimum bend radius. An arc smaller than a few inches in diameter can damage the cable and cause problems that are difficult to diagnose.

List of Technical Publications

Table 10 on page 57 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 11 on page 61 lists the books included in the *Network Operations Guide* series. Table 12 on page 62 lists the manuals and release notes supporting JUNOS software with enhanced services. All documents are available at <http://www.juniper.net/techpubs/>.

Table 13 on page 63 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 10: Technical Documentation for Supported Routing Platforms

Book	Description
JUNOS Software for Supported Routing Platforms	
<i>Access Privilege</i>	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.
<i>Class of Service</i>	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.
<i>CLI User Guide</i>	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 <i>JUNOS System Basics Configuration Guide</i> .
<i>Feature Guide</i>	Provides a detailed explanation and configuration examples for several of the most complex features in the JUNOS software.
<i>High Availability</i>	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).
<i>MPLS Applications</i>	Provides an overview of traffic engineering concepts and describes how to configure traffic engineering protocols.
<i>Multicast Protocols</i>	Provides an overview of multicast concepts and describes how to configure multicast routing protocols.
<i>Multiplay Solutions</i>	Describes how you can deploy IPTV and voice over IP (VoIP) services in your network.

Table 10: Technical Documentation for Supported Routing Platforms *(continued)*

Book	Description
<i>MX-series Layer 2 Configuration Guide</i>	Provides an overview of the Layer 2 functions of the MX-series routers, including configuring bridging domains, MAC address and VLAN learning and forwarding, and spanning-tree protocols. It also details the routing instance types used by Layer 2 applications. All of this material was formerly covered in the <i>JUNOS Routing Protocols Configuration Guide</i> .
<i>MX-series Layer 2 Solutions Guide</i>	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).
<i>Network Interfaces</i>	Provides an overview of the network interface functions of the JUNOS software and describes how to configure the network interfaces on the routing platform.
<i>Network Management</i>	Provides an overview of network management concepts and describes how to configure various network management features, such as SNMP and accounting options.
<i>Policy Framework</i>	Provides an overview of policy concepts and describes how to configure routing policy, firewall filters, and forwarding options.
<i>Protected System Domain</i>	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.
<i>Routing Protocols</i>	Provides an overview of routing concepts and describes how to configure routing instances, and unicast routing protocols.
<i>Secure Configuration Guide for Common Criteria and JUNOS-FIPS</i>	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.
<i>Services Interfaces</i>	Provides an overview of the services interfaces functions of the JUNOS software and describes how to configure the services interfaces on the router.
<i>Software Installation and Upgrade Guide</i>	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 <i>JUNOS System Basics Configuration Guide</i> .
<i>Subscriber Access</i>	Provides an overview of the subscriber access features of the JUNOS software and describes how to configure subscriber access support on the router, including dynamic profiles, class of service, AAA, and access methods.

Table 10: Technical Documentation for Supported Routing Platforms (continued)

Book	Description
<i>System Basics</i>	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.
<i>VPNs</i>	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	
<i>Hierarchy and RFC Reference</i>	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 <i>JUNOS System Basics Configuration Guide</i> .
<i>Interfaces Command Reference</i>	Describes the JUNOS software operational mode commands you use to monitor and troubleshoot interfaces.
<i>Routing Protocols and Policies Command Reference</i>	Describes the JUNOS software operational mode commands you use to monitor and troubleshoot routing policies and protocols, including firewall filters.
<i>System Basics and Services Command Reference</i>	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.
<i>System Log Messages Reference</i>	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	
<i>J-Web Interface User Guide</i>	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	
<i>JUNOScript API Guide</i>	Describes how to use the JUNOScript application programming interface (API) to monitor and configure Juniper Networks routing platforms.
<i>JUNOS XML API Configuration Reference</i>	Provides reference pages for the configuration tag elements in the JUNOS XML API.
<i>JUNOS XML API Operational Reference</i>	Provides reference pages for the operational tag elements in the JUNOS XML API.
<i>NETCONF API Guide</i>	Describes how to use the NETCONF API to monitor and configure Juniper Networks routing platforms.

Table 10: Technical Documentation for Supported Routing Platforms *(continued)*

Book	Description
<i>JUNOS Configuration and Diagnostic Automation Guide</i>	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	
<i>Hardware Guide</i>	Describes how to install, maintain, and troubleshoot routing platforms and components. Each platform has its own hardware guide.
<i>PIC Guide</i>	Describes the routing platform's Physical Interface Cards (PICs). Each platform has its own PIC guide.
<i>DPC Guide</i>	Describes the Dense Port Concentrators (DPCs) for all MX-series routers.
JUNOScope Documentation	
<i>JUNOScope Software User Guide</i>	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	
<i>Advanced Insight Solutions Guide</i>	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	
<i>Getting Started Guide</i>	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 <i>Getting Started Guide</i> for your router model.
<i>Basic LAN and WAN Access Configuration Guide</i>	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.
<i>Advanced WAN Access Configuration Guide</i>	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.
<i>Administration Guide</i>	Shows how to manage users and operations, monitor network performance, upgrade software, and diagnose common problems on J-series Services Routers.
Release Notes	

Table 10: Technical Documentation for Supported Routing Platforms *(continued)*

Book	Description
<i>JUNOS Release Notes</i>	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.
<i>Hardware Release Notes</i>	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.
<i>JUNOScope Release Notes</i>	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.
<i>AIS Release Notes</i>	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.
<i>AIS AI-Scripts Release Notes</i>	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.
<i>J-series Services Router Release Notes</i>	Briefly describe Services Router features, identify known hardware problems, and provide upgrade and downgrade instructions.

Table 11: JUNOS Software Network Operations Guides

Book	Description
<i>Baseline</i>	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.
<i>Interfaces</i>	Describes tasks for monitoring interfaces. Tasks include using loopback testing and locating alarms.
<i>MPLS</i>	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.
<i>MPLS Log Reference</i>	Describes MPLS status and error messages that appear in the output of the <code>show mpls lsp extensive</code> 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.

Table 11: JUNOS Software Network Operations Guides (*continued*)

Book	Description
<i>MPLS Fast Reroute</i>	Describes operational information helpful in monitoring and troubleshooting an MPLS network configured with fast reroute (FRR) and load balancing.
<i>Hardware</i>	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 12: JUNOS Software with Enhanced Services Documentation

Book	Description
All Platforms	
<i>JUNOS Software Interfaces and Routing Configuration Guide</i>	Explains how to configure J-series interfaces for basic IP routing with standard routing protocols, ISDN service, firewall filters (access control lists), and class-of-service (CoS) traffic classification.
<i>JUNOS Software Security Configuration Guide</i>	Explains how to configure and manage security services such as stateful firewall policies, IP Security (IPsec) virtual private networks (VPNs), firewall screens, Network Address Translation (NAT), Public Key Cryptography, and Application Layer Gateways (ALGs).
<i>JUNOS Software Administration Guide</i>	Shows how to monitor J-series devices 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.
<i>JUNOS Software CLI Reference</i>	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.
J-series Only	
<i>JUNOS Software with Enhanced Services Design and Implementation Guide</i>	Provides guidelines and examples for designing and implementing IPsec VPNs, firewalls, and routing on J-series Services Routers running JUNOS software with enhanced services.
<i>JUNOS Software with Enhanced Services Quick Start</i>	Explains how to quickly set up a J-series Services Router. This document contains router declarations of conformity.

Table 12: JUNOS Software with Enhanced Services Documentation (continued)

Book	Description
<i>JUNOS Software with Enhanced Services J-series Services Router Hardware Guide</i>	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.
<i>JUNOS Software with Enhanced Services Migration Guide</i>	Provides instructions for migrating an SSG device running ScreenOS software or a J-series Services Router running the JUNOS software to JUNOS software with enhanced services.
<i>WXC Integrated Services Module Installation and Configuration Guide</i>	Explains how to install and initially configure a WXC Integrated Services Module in a J-series Services Router for application acceleration.
<i>JUNOS Software with Enhanced Services for J-series Services Router Release Notes</i>	Summarizes new features and known problems for a particular release of JUNOS software with enhanced services on J-series Services 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 13: Additional Books Available Through <http://www.juniper.net/books>

Book	Description
<i>Interdomain Multicast Routing</i>	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.
<i>JUNOS Cookbook</i>	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.
<i>MPLS-Enabled Applications</i>	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.
<i>OSPF and IS-IS: Choosing an IGP for Large-Scale Networks</i>	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.

Table 13: Additional Books Available Through <http://www.juniper.net/books> (continued)

Book	Description
<i>Routing Policy and Protocols for Multivendor IP Networks</i>	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.
<i>The Complete IS-IS Protocol</i>	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 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 Management tool: <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 Management 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

27 October 2008—530-023240-01. Revision 2. Removed EOL M320-FPC1, M320-FPC2, M320-FPC3, T320-FPC1-E, T320-FPC2-E, T320-FPC3-E, T640-FPC1-E, T640-FPC2-E, and T640-FPC3-E.

1 February 2008—530-023240-01. Revision 1. Added T1600-FPC3-ES for the T640 and T1600 routing nodes. Removed the M20 router.

19 October 2007—530-021928-01. Revision 1. Added T1600-FPC4 for the T1600 routing node.

25 June 2007—530-021110-01. Revision 1. Added Enhanced III FPCs. Added the first supported JUNOS Release for each FPC. Corrected the throughput of the Enhanced II FPC1 and Enhanced II FPC2 for the M320 router, T320 router, and T640 routing node.

6 October 2006—530-016145-01. Revision 1. Added M120 FPCs. Removed the M40 router, Enhanced M20/M40 FPC (FPC-E and FPC-E-U), M40e-FPC1, and M40e-FPC2.

28 June 2006—530-015179-01. Revision 2. Corrected throughput of the Enhanced Plus FPC2.

9 January 2006—530-015179-01. Revision 1. Added Enhanced II FPCs for the M320 router and the Enhanced Scaling FPC4 for the T640 routing node.

14 September 2005—530-012710-01. Revision 4. Added Enhanced II FPCs for the T320 and T640 routing platforms and removed M160 FPC information.

13 June 2005—530-012710-01. Revision 3. Added Enhanced Plus FPC2 information for the M40e router.

5 April 2005—530-012710-01. Revision 2. Added Enhanced Plus FPC information for the M20 and M40e routers.

19 January 2005—530-012710-01. Revision 1. Added FPC installation instructions for the M320 and T320 routers and the T640 routing node.

1 October 2002—530-005362-01. Revision 2. Updated technical support information.

21 January 2001—530-005362-01. Revision 1. Added FPC installation instructions for the M40e router.

31 March 2000—530-001669-01. Revision 2. Added FPC installation instructions for the M160 router.

20 December 1999—530-001669-01. Revision 1.

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