MX Series 3D Universal Edge Router Line Card Guide

April 2012

Contents

MX Series DPCs

MX Series DPC Overview

A DPC provides multiple physical interfaces and Packet Forwarding Engines on a single board that installs into a slot within the MX240, MX480, and MX960 3D Universal Edge Routers. A DPC receives incoming packets from the network and sends outgoing packets to the network. The Packet Forwarding Engines on a DPC are equipped with purpose-built ASICs that perform packet processing and forwarding.

When a slot is not occupied by a DPC, you must insert a blank DPC to fill the empty slot and ensure proper cooling of the system. For complete information about installing and handling DPCs, see the hardware guide for your router.

Related Documentation

- DPCs Supported on MX240, MX480, and MX960 Routers on page 6
- Protocols and Applications Supported by DPCs and Enhanced DPCs (DPC and DPCE-R) on page 49
- Protocols and Applications Supported by Enhanced Ethernet Services DPCs (DPCE-X) on page 56
- Protocols and Applications Supported by Enhanced Queuing IP Services DPCs (DPCE-R-Q) on page 61

DPCs Supported on MX240, MX480, and MX960 Routers

Table 1 on page 6 lists the DPCs supported by the MX240, MX480, and MX960 routers.

Table 1: DPCs Supported in MX240, MX480, and MX960 Routers

DPC Name	DPC Model Number	Ports	Maximum Throughput per DPC	First Junos OS Release
Gigabit Ethernet				
"Gigabit Ethernet DPC with SFP" on page 8	DPC-R-40GE-SFP EOL (see PSN-2009-06-400)	40	40 Gbps	8.2
"Gigabit Ethernet Enhanced DPC with SFP" on page 11	DPCE-R-40GE-SFP	40	40 Gbps	8.4
"Gigabit Ethernet Enhanced Ethernet Services DPC with SFP" on page 14	DPCE-X-40GE-SFP	40	40 Gbps	8.4
"Gigabit Ethernet Enhanced Queuing Ethernet Services DPC with SFP" on page 17	DPCE-X-Q-40GE-SFP	40	40 Gbps	8.5
"Gigabit Ethernet Enhanced Queuing IP Services DPCs with SFP" on page 20	DPCE-R-Q-20GE-SFP	20	20 Gbps	9.1
"Gigabit Ethernet Enhanced Queuing IP Services DPCs with SFP" on page 20	DPCE-R-Q-40GE-SFP	40	40 Gbps	8.5
"10-Gigabit Ethernet DPC with XFP" on page 24	DPC-R-4XGE-XFP EOL (see PSN-2009-06-400)	4	40 Gbps	8.2
10-Gigabit Ethernet				
"10-Gigabit Ethernet Enhanced DPCs with XFP" on page 26	DPCE-R-2XGE-XFP	2	20 Gbps	9.1
"10-Gigabit Ethernet Enhanced DPCs with XFP" on page 26	DPCE-R-4XGE-XFP	4	40 Gbps	8.4
"10-Gigabit Ethernet Enhanced Ethernet Services DPC with XFP" on page 28	DPCE-X-4XGE-XFP	4	40 Gbps	8.4
"10-Gigabit Ethernet Enhanced Queuing Ethernet Services DPC with XFP" on page 30	DPCE-X-Q-4XGE-XFP	4	40 Gbps	8.5
"10-Gigabit Ethernet Enhanced Queuing IP Services DPC with XFP" on page 32	DPCE-R-Q-4XGE-XFP	4	40 Gbps	8.5
Mulit-Rate Ethernet				

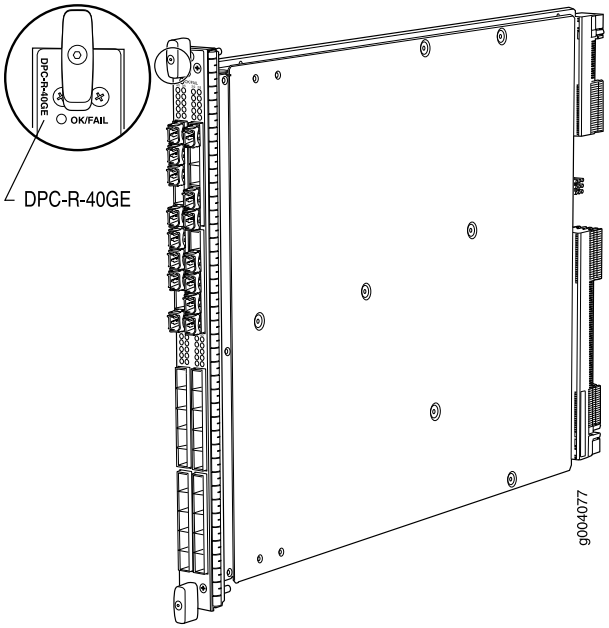
Table 1: DPCs Supported in MX240, MX480, and MX960 Routers *(continued)*

DPC Name	DPC Model Number	Ports	Maximum Throughput per DPC	First Junos OS Release
"Multi-Rate Ethernet Enhanced DPC with SFP and XFP" on page 34	DPCE-R-20GE-2XGE	22	40 Gbps	9.2
"Multi-Rate Ethernet Enhanced Ethernet Services DPC with SFP and XFP" on page 37	DPCE-X-20GE-2XGE	22	40 Gbps	9.2
"Multi-Rate Ethernet Enhanced Queuing IP Services DPC with SFP and XFP" on page 40	DPCE-R-Q-20GE-2XGE	22	40 Gbps	9.3
Tri-Rate Ethernet				
"Tri-Rate Enhanced DPC" on page 45	DPCE-R-40GE-TX	40	40 Gbps	9.1
"Tri-Rate Enhanced Ethernet Services DPC" on page 47	DPCE-X-40GE-TX	40	40 Gbps	9.1
Services				
"Multiservices DPC" on page 43	MS-DPC	2 (Not supported)	–	9.3

Related Documentation

- MX Series DPC Overview on page 4
- Protocols and Applications Supported by DPCs and Enhanced DPCs (DPC and DPCE-R) on page 49
- Protocols and Applications Supported by Enhanced Ethernet Services DPCs (DPCE-X) on page 56
- Protocols and Applications Supported by Enhanced Queuing IP Services DPCs (DPCE-R-Q) on page 61
- Protocols and Applications Supported by Enhanced Queuing Ethernet Services DPCs (DPCE-X-Q) on page 66
- Protocols and Applications Supported by the Multiservices DPC (MS-DPC) on page 71

Gigabit Ethernet DPC with SFP



Software release	• Junos OS Release 8.2 and later • End-of-life (see notification PSN-2009-06-400)
Description	• 40 Gigabit Ethernet ports • Power requirement: 6.98 A @ 48 V (335 W) • Weight: 13.1 lb (5.9 kg) • Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network • Model number: DPC-R-40GE-SFP
Hardware features	• High-performance throughput on each port at speeds up to 1 Gbps • Autonegotiation between Gigabit Ethernet circuit partners • Full-duplex mode • Maximum transmission units (MTUs) of up to 9192 bytes
Software features	• Optical diagnostics and related alarms • See "Protocols and Applications Supported by DPCs and Enhanced DPCs (DPC and DPCE-R)" on page 49 for information about the protocols and applications that this DPC supports.

Cables and connectors

- You can install any transceiver supported by the DPC. For information about installing and removing transceivers, see the hardware guide for your router.
- Fiber-optic small form-factor pluggable (SFP) transceivers:
  - Connector: Duplex LC/PC (Rx and Tx)
  - 1000BASE-EX (model number: SFP-GE40KM)
  - 1000BASE-LH (model number: SFP-1GE-LH)
  - 1000BASE-LX (model number: SFP-1GE-LX)
  - 1000BASE-SX (model number: SFP-1GE-SX)

  Optical interface specifications—see Gigabit Ethernet 1000BASE Optical Interface Specifications
- Copper SFP transceivers:
  - Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
  - 1000BASE-T (model number: SFP-1GE-T)
  - Pinout: MDI crossover
  - Length: 328 ft/100 m

  Copper interface specifications—see Gigabit Ethernet 1000BASE-T Copper Interface Specifications
- Bidirectional SFP transceivers:
  - Connector: Duplex LC/PC (Rx and Tx)
  - 1000BASE-BX (model number pairs: SFP-GE10KT13R14 with SFP-GE10KT14R13, SFP-GE10KT13R15 with SFP-GE10KT15R13, SFP-GE40KT13R15 with SFP-GE40KT15R13)

  Optical interface specifications—see Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications

NOTE: Do not install Gigabit Ethernet SFPs in the SONET/SDH port. The port will not recognize the SFP.

LEDs

OK/FAIL LED, one bicolor:

- Steady green—DPC is functioning normally.
- Blinking green—DPC is transitioning online or offline.
- Red—DPC has failed.

Link LED, one green per port:

- Off—No link.
- On steadily—Link is active.

The Link LEDs are labeled in groups of five:

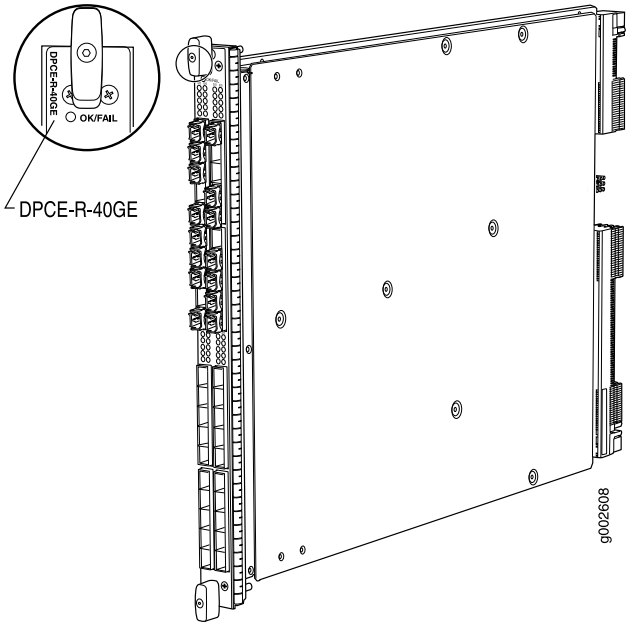
- **0/0** for **0/0** through **0/4**
- **0/5** for **0/5** through **0/9**
- **1/0** for **1/0** through **1/4**
- **1/5** for **1/5** through **1/9**
- **2/0** for **2/0** through **2/4**
- **2/5** for **2/5** through **2/9**
- **3/0** for **3/0** through **3/4**
- **3/5** for **3/5** through **3/9**

Related Documentation

- MX Series DPC Overview on page 4
- DPCs Supported on MX240, MX480, and MX960 Routers on page 6

- Gigabit Ethernet 1000BASE Optical Interface Specifications
- Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications

Gigabit Ethernet Enhanced DPC with SFP



Software release	• Junos OS Release 8.4 and later
Description	• 40 Gigabit Ethernet ports • Power requirement: 6.98 A @ 48 V (335 W) • Weight: 13.1 lb (5.9 kg) • Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network • Model number: DPCE-R-40GE-SFP
Hardware features	• High-performance throughput on each port at speeds up to 1 Gbps • Autonegotiation between Gigabit Ethernet circuit partners • Full-duplex mode • Maximum transmission units (MTUs) of up to 9192 bytes • Enhanced ASICs for increased performance and scalability of Layer 2 features
Software features	• Optical diagnostics and related alarms • See "Protocols and Applications Supported by DPCs and Enhanced DPCs (DPC and DPCE-R)" on page 49 for information about the protocols and applications that this DPC supports.

Cables and connectors

- You can install any transceiver supported by the DPC. For information about installing and removing transceivers, see the hardware guide for your router.
- Fiber-optic small form-factor pluggable (SFP) transceivers:
  - Connector: Duplex LC/PC (Rx and Tx)
  - 1000BASE-EX (model number: SFP-GE40KM)
  - 1000BASE-LH (model number: SFP-1GE-LH)
  - 1000BASE-LX (model number: SFP-1GE-LX)
  - 1000BASE-SX (model number: SFP-1GE-SX)

  Optical interface specifications—see Gigabit Ethernet 1000BASE Optical Interface Specifications
- Copper SFP transceivers:
  - Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
  - 1000BASE-T (model number: SFP-1GE-T)
  - Pinout: MDI
  - Length: 328 ft/100 m

  Copper interface specifications—see Gigabit Ethernet 1000BASE-T Copper Interface Specifications
- Bidirectional SFP transceivers:
  - Connector: Duplex LC/PC (Rx and Tx)
  - 1000BASE-BX (model number pairs: SFP-GE10KT13R14 with SFP-GE10KT14R13, SFP-GE10KT13R15 with SFP-GE10KT15R13, SFP-GE40KT13R15 with SFP-GE40KT15R13)

  Optical interface specifications—see Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications

NOTE: Do not install Gigabit Ethernet SFPs in the SONET/SDH port. The port will not recognize the SFP.

LEDs

OK/FAIL LED, one bicolor:

- Steady green—DPC is functioning normally.
- Blinking green—DPC is transitioning online or offline.
- Red—DPC has failed.

Link LED, one green per port:

- Off—No link.
- On steadily—Link is active.

The Link LEDs are labeled in groups of five:

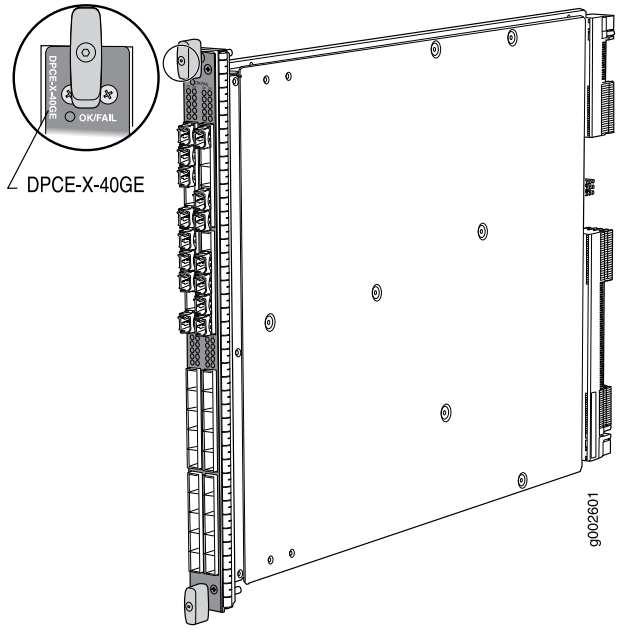
- **0/0** for **0/0** through **0/4**
- **0/5** for **0/5** through **0/9**
- **1/0** for **1/0** through **1/4**
- **1/5** for **1/5** through **1/9**
- **2/0** for **2/0** through **2/4**
- **2/5** for **2/5** through **2/9**
- **3/0** for **3/0** through **3/4**
- **3/5** for **3/5** through **3/9**

Related Documentation

- MX Series DPC Overview on page 4
- DPCs Supported on MX240, MX480, and MX960 Routers on page 6

- Gigabit Ethernet 1000BASE Optical Interface Specifications
- Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications

Gigabit Ethernet Enhanced Ethernet Services DPC with SFP



Software release	• Junos OS Release 8.4 and later
Description	• 40 Gigabit Ethernet ports • Power requirement: 6.98 A @ 48 V (335 W) • Weight: 13.1 lb (5.9 kg) • Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network • Model number: DPCE-X-40GE-SFP
Hardware features	• High-performance throughput on each port at speeds up to 1 Gbps • Autonegotiation between Gigabit Ethernet circuit partners • Full-duplex mode • Maximum transmission units (MTUs) of up to 9192 bytes • Enhanced ASICs for increased performance and scalability of Layer 2 features
Software features	• Optical diagnostics and related alarms • See "Protocols and Applications Supported by Enhanced Ethernet Services DPCs (DPCE-X)" on page 56 for information about the protocols and applications that this DPC supports. NOTE: The routing table is limited to 32,000 IP routes. This limitation applies to any manner in which the routes are learned, such as OSPF, RIP, and so on. The DPC supports BGP for L2 VPNs only.

Cables and connectors

- You can install any transceiver supported by the DPC. For information about installing and removing transceivers, see the hardware guide for your router.
- Fiber-optic small form-factor pluggable (SFP) transceivers:
  - Connector: Duplex LC/PC (Rx and Tx)
  - 1000BASE-EX (model number: SFP-GE40KM)
  - 1000BASE-LH (model number: SFP-1GE-LH)
  - 1000BASE-LX (model number: SFP-1GE-LX)
  - 1000BASE-SX (model number: SFP-1GE-SX)

  Optical interface specifications—see Gigabit Ethernet 1000BASE Optical Interface Specifications
- Copper SFP transceivers:
  - Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
  - 1000BASE-T (model number: SFP-1GE-T)
  - Pinout: MDI crossover
  - Length: 328 ft/100 m

  Copper interface specifications—see Gigabit Ethernet 1000BASE-T Copper Interface Specifications
- Bidirectional SFP transceivers:
  - Connector: Duplex LC/PC (Rx and Tx)
  - 1000BASE-BX (model number pairs: SFP-GE10KT13R14 with SFP-GE10KT14R13, SFP-GE10KT13R15 with SFP-GE10KT15R13, SFP-GE40KT13R15 with SFP-GE40KT15R13)

  Optical interface specifications—see Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications

NOTE: Do not install Gigabit Ethernet SFPs in the SONET/SDH port. The port will not recognize the SFP.

LEDs

OK/FAIL LED, one bicolor:

- Steady green—DPC is functioning normally.
- Blinking green—DPC is transitioning online or offline.
- Red—DPC has failed.

Link LED, one green per port:

- Off—No link.
- On steadily—Link is active.

The Link LEDs are labeled in groups of five:

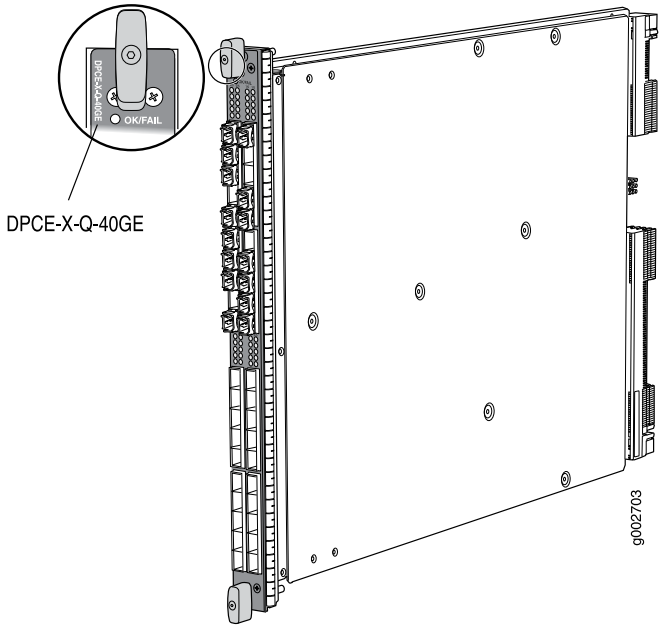
- **0/0** for **0/0** through **0/4**
- **0/5** for **0/5** through **0/9**
- **1/0** for **1/0** through **1/4**
- **1/5** for **1/5** through **1/9**
- **2/0** for **2/0** through **2/4**
- **2/5** for **2/5** through **2/9**
- **3/0** for **3/0** through **3/4**
- **3/5** for **3/5** through **3/9**

Related Documentation

- MX Series DPC Overview on page 4
- DPCs Supported on MX240, MX480, and MX960 Routers on page 6

- Gigabit Ethernet 1000BASE Optical Interface Specifications
- Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications

Gigabit Ethernet Enhanced Queuing Ethernet Services DPC with SFP



Software release	• Junos OS Release 8.5 and later
Description	• 40 Gigabit Ethernet ports • Power requirement: 7.6 A @ 48 V (365 W) • Weight: 13.1 lb (5.9 kg) • Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network • Model number: DPCE-X-Q-40GE-SFP
Hardware features	• High-performance throughput on each port at speeds up to 1 Gbps • Autonegotiation between Gigabit Ethernet circuit partners • Full-duplex mode • Maximum transmission units (MTUs) of up to 9192 bytes • Enhanced ASICs for increased performance and scalability of Layer 2 features
Software features	• Optical diagnostics and related alarms • See "Protocols and Applications Supported by Enhanced Queuing Ethernet Services DPCs (DPCE-X-Q)" on page 66 for information about the protocols and applications that this DPC supports. NOTE: The routing table is limited to 32,000 IP routes. This limitation applies to any manner in which the routes are learned, such as OSPF, RIP, and so on. The DPC supports BGP for L2 VPNs only.

Cables and connectors	• You can install any transceiver supported by the DPC. For information about installing and removing transceivers, see the hardware guide for your router.
	• Fiber-optic small form-factor pluggable (SFP) transceivers:
	  • Connector: Duplex LC/PC (Rx and Tx)
	  • 1000BASE-EX (model number: SFP-GE40KM)
	  • 1000BASE-LH (model number: SFP-1GE-LH)
	  • 1000BASE-LX (model number: SFP-1GE-LX)
	  • 1000BASE-SX (model number: SFP-1GE-SX)
	  Optical interface specifications—see Gigabit Ethernet 1000BASE Optical Interface Specifications
	• Copper SFP transceivers:
	  • Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
	  • 1000BASE-T (model number: SFP-1GE-T)
	  • Pinout: MDI crossover
	  • Length: 328 ft/100 m
	  Copper interface specifications—see Gigabit Ethernet 1000BASE-T Copper Interface Specifications
	• Bidirectional SFP transceivers:
	  • Connector: Duplex LC/PC (Rx and Tx)
	  • 1000BASE-BX (model number pairs: SFP-GE10KT13R14 with SFP-GE10KT14R13, SFP-GE10KT13R15 with SFP-GE10KT15R13, SFP-GE40KT13R15 with SFP-GE40KT15R13)
	  Optical interface specifications—see Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications
	
	NOTE: Do not install Gigabit Ethernet SFPs in the SONET/SDH port. The port will not recognize the SFP.

LEDs	**OK/FAIL** LED, one bicolor: • Steady green—DPC is functioning normally. • Blinking green—DPC is transitioning online or offline. • Red—DPC has failed. Link LED, one green per port: • Off—No link. • On steadily—Link is active. The Link LEDs are labeled in groups of five: • **0/0** for **0/0** through **0/4** • **0/5** for **0/5** through **0/9** • **1/0** for **1/0** through **1/4** • **1/5** for **1/5** through **1/9** • **2/0** for **2/0** through **2/4** • **2/5** for **2/5** through **2/9** • **3/0** for **3/0** through **3/4** • **3/5** for **3/5** through **3/9**
Related Documentation	• MX Series DPC Overview on page 4 • DPCs Supported on MX240, MX480, and MX960 Routers on page 6

- Gigabit Ethernet 1000BASE Optical Interface Specifications
- Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications

Gigabit Ethernet Enhanced Queuing IP Services DPCs with SFP

Figure 1: 20-Port Gigabit Ethernet Enhanced Queuing IP Services DPC with SFP

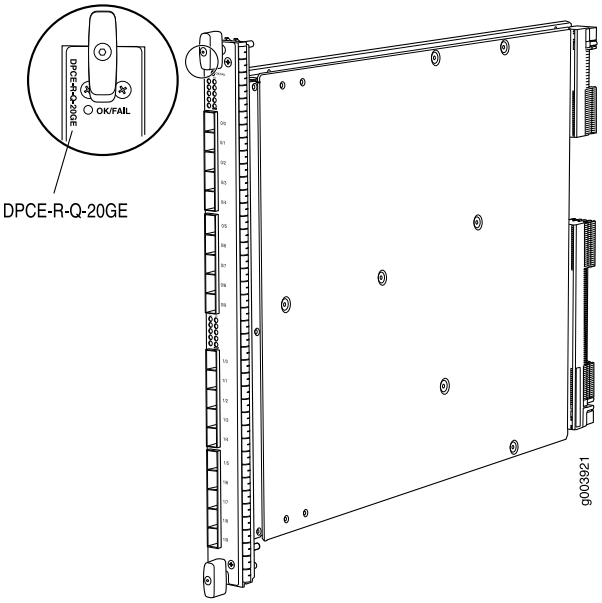
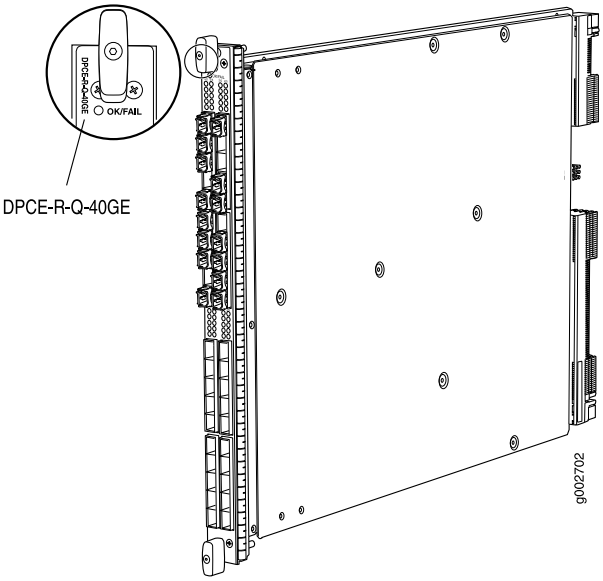


Figure 2: 40-Port Gigabit Ethernet Enhanced Queuing IP Services DPC with SFP



Software release	• 20-port: Junos OS Release 9.1 and later • 40-port: Junos OS Release 8.5 and later

Description	• 20 or 40 Gigabit Ethernet ports
	• Power requirement:
	  ◦ 20-port: 4.2 A @ 48 V (200 W)
	  ◦ 40-port: 7.6 A @ 48 V (365 W)
	• Weight:
	  ◦ 20-port: 13 lb (5.9 kg)
	  ◦ 40-port: 13.1 lb (5.9 kg)
	• Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network
	• Model numbers:
	  ◦ 20-port: DPCE-R-Q-20GE-SFP
	  ◦ 40-port: DPCE-R-Q-40GE-SFP

Hardware features	• High-performance throughput on each port at speeds up to 1 Gbps • Autonegotiation between Gigabit Ethernet circuit partners • Full-duplex mode • Maximum transmission units (MTUs) of up to 9192 bytes • Enhanced ASICs for increased performance and scalability of Layer 2 features
Software features	• Optical diagnostics and related alarms • See "Protocols and Applications Supported by Enhanced Queuing IP Services DPCs (DPCE-R-Q)" on page 61 for information about the protocols and applications that this DPC supports.

Cables and connectors

- You can install any transceiver supported by the DPC. For information about installing and removing transceivers, see the hardware guide for your router.
- Fiber-optic small form-factor pluggable (SFP) transceivers:
  - Connector: Duplex LC/PC (Rx and Tx)
  - 1000BASE-EX (model number: SFP-GE40KM)
  - 1000BASE-LH (model number: SFP-1GE-LH)
  - 1000BASE-LX (model number: SFP-1GE-LX)
  - 1000BASE-SX (model number: SFP-1GE-SX)

  Optical interface specifications—see Gigabit Ethernet 1000BASE Optical Interface Specifications
- Copper SFP transceivers:
  - Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
  - 1000BASE-T (model number: SFP-1GE-T)
  - Pinout: MDI crossover
  - Length: 328 ft/100 m

  Copper interface specifications—see Gigabit Ethernet 1000BASE-T Copper Interface Specifications
- Bidirectional SFP transceivers:
  - Connector: Duplex LC/PC (Rx and Tx)
  - 1000BASE-BX (model number pairs: SFP-GE10KT13R14 with SFP-GE10KT14R13, SFP-GE10KT13R15 with SFP-GE10KT15R13, SFP-GE40KT13R15 with SFP-GE40KT15R13)

  Optical interface specifications—see Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications

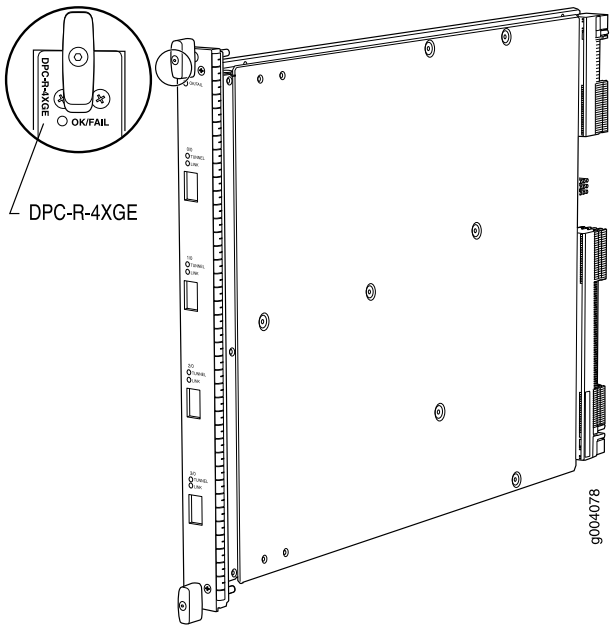
NOTE: Do not install Gigabit Ethernet SFPs in the SONET/SDH port. The port will not recognize the SFP.

LEDs	**OK/FAIL** LED, one bicolor:
	• Steady green—DPC is functioning normally.
	• Blinking green—DPC is transitioning online or offline.
	• Red—DPC has failed.
	Link LED, one green per port:
	• Off—No link.
	• On steadily—Link is active.
	The Link LEDs are labeled in groups of five:
	• 20-port:
	  • **0/0** for **0/0** through **0/4**
	  • **0/5** for **0/5** through **0/9**
	  • **1/0** for **1/0** through **1/4**
	  • **1/5** for **1/5** through **1/9**
	• 40-port:
	  • **0/0** for **0/0** through **0/4**
	  • **0/5** for **0/5** through **0/9**
	  • **1/0** for **1/0** through **1/4**
	  • **1/5** for **1/5** through **1/9**
	  • **2/0** for **2/0** through **2/4**
	  • **2/5** for **2/5** through **2/9**
	  • **3/0** for **3/0** through **3/4**
	  • **3/5** for **3/5** through **3/9**

Related Documentation

- MX Series DPC Overview on page 4
- DPCs Supported on MX240, MX480, and MX960 Routers on page 6
- Gigabit Ethernet 1000BASE Optical Interface Specifications
- Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications

10-Gigabit Ethernet DPC with XFP



Software release	• Junos OS Release 8.2 and later • End-of-life (see notification PSN-2009-06-400)
Description	• Four 10-Gigabit Ethernet ports • Power requirement: 6.46 A @ 48 V (310 W) • Weight: 13.1 lb (5.9 kg) • Model number: DPC-R-4XGE-XFP
Hardware features	• High-performance throughput on each port at speeds up to 10 Gbps • WAN-PHY mode at 9.953 Gbps • LAN-PHY mode at 10.3125 Gbps • Full-duplex mode • Maximum transmission units (MTUs) of up to 9192 bytes
Software features	• Configurable WAN-PHY mode options • See "Protocols and Applications Supported by DPCs and Enhanced DPCs (DPC and DPCE-R)" on page 49 for information about the protocols and applications that this DPC supports.

Cables and connectors	• You can install any transceiver supported by the DPC. For information about installing and removing transceivers, see the hardware guide for your router.
	• Fiber-optic 10-gigabit small form-factor pluggable (XFP) transceivers:
	  ◦ Connector: Duplex LC/PC (Rx and Tx)
	  ◦ 10GBASE-E (model number: XFP-10G-E-OC192-IR2)
	  ◦ 10GBASE-L (model number: XFP-10G-L-OC192-SR1)
	  ◦ 10GBASE-S (model number: XFP-10G-S)
	  ◦ 10GBASE-Z (model number: XFP-10G-Z-OC192-LR2)
	Optical interface specifications—see 10-Gigabit Ethernet 10GBASE Optical Interface Specifications

LEDs	**OK/FAIL** LED, one bicolor: • Steady green—DPC is functioning normally. • Blinking green—DPC is transitioning online or offline. • Red—DPC has failed. **TUNNEL** LED, one green per port: • Off—Normal operating mode. • On steadily—Port configured in tunnel mode. **LINK** LED, one green per port: • Off—No link. • On steadily—Link is active. The **TUNNEL** and **LINK** LEDs are labeled top to bottom **0/0** through **3/0**.

Related Documentation

- MX Series DPC Overview on page 4
- DPCs Supported on MX240, MX480, and MX960 Routers on page 6
- 10-Gigabit Ethernet 10GBASE Optical Interface Specifications

10-Gigabit Ethernet Enhanced DPCs with XFP

Figure 3: 2-Port 10-Gigabit Ethernet Enhanced DPC with XFP

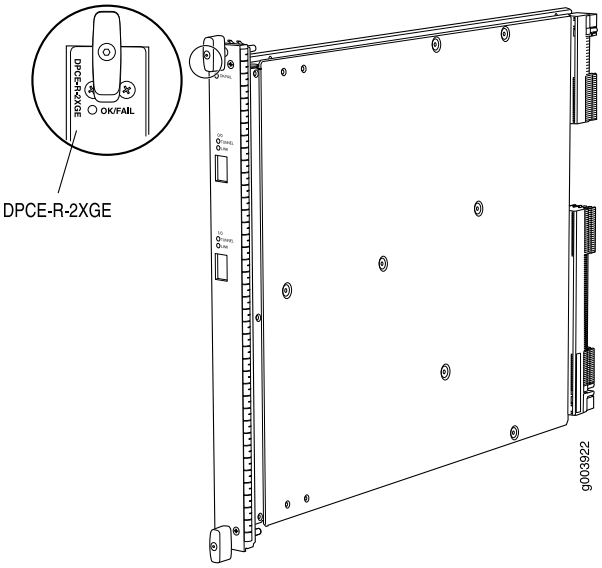
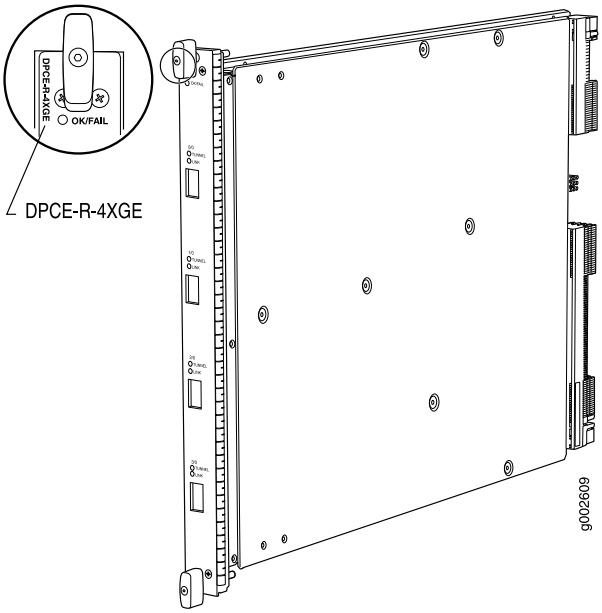


Figure 4: 4-Port 10-Gigabit Ethernet Enhanced DPC with XFP



Software release	• 2-port: Junos OS Release 9.1 and later • 4-port: Junos OS Release 8.4 and later

Description	• Two or four 10-Gigabit Ethernet ports
	• Power requirement:
	  ◦ 2-port: 3.65 A @ 48 V (175 W)
	  ◦ 4-port: 6.46 A @ 48 V (310 W)
	• Weight:
	  ◦ 2-port: 12 lb (5.4 kg)
	  ◦ 4-port: 13.1 lb (5.9 kg)
	• Model number:
	  ◦ 2-port: DPCE-R-2XGE-XFP
	  ◦ 4-port: DPCE-R-4XGE-XFP

Hardware features	• High-performance throughput on each port at speeds up to 10 Gbps • WAN-PHY mode at 9.953 Gbps • LAN-PHY mode at 10.3125 Gbps • Full-duplex mode • Maximum transmission units (MTUs) of up to 9192 bytes • Enhanced ASICs for increased performance and scalability of Layer 2 features
Software features	• Configurable WAN-PHY mode options • See "Protocols and Applications Supported by DPCs and Enhanced DPCs (DPC and DPCE-R)" on page 49 for information about the protocols and applications that this DPC supports.

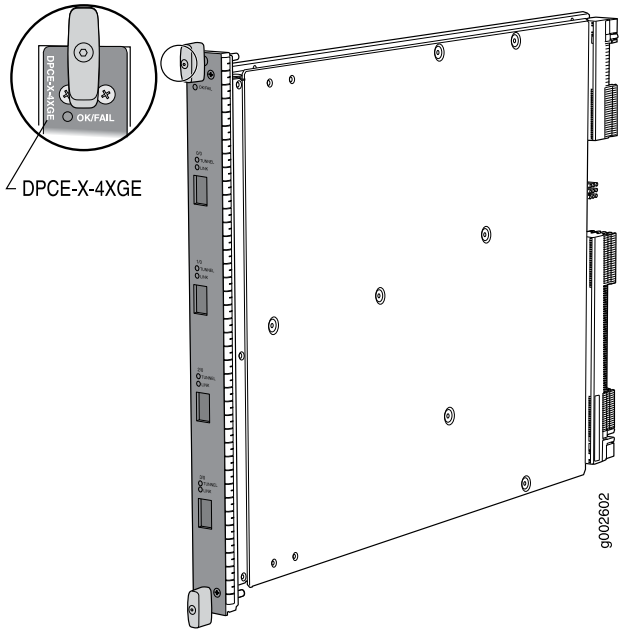
Cables and connectors	• You can install any transceiver supported by the DPC. For information about installing and removing transceivers, see the hardware guide for your router.
	• Fiber-optic 10-gigabit small form-factor pluggable (XFP) transceivers:
	  • Connector: Duplex LC/PC (Rx and Tx)
	  • 10GBASE-E (model number: XFP-10G-E-OC192-IR2)
	  • 10GBASE-L (model number: XFP-10G-L-OC192-SR1)
	  • 10GBASE-S (model number: XFP-10G-S)
	  • 10GBASE-Z (model number: XFP-10G-Z-OC192-LR2)
	  Optical interface specifications—see 10-Gigabit Ethernet 10GBASE Optical Interface Specifications
	• DWDM Tunable XFP transceivers:
	  • Connector: Duplex LC/PC (Rx and Tx)
	  • 10GBASE-ZR (model number: XFP-10G-CBAND-T50-ZR)
	  DWDM supported wavelengths—see 10-Gigabit Ethernet DWDM Transceiver Wavelengths
	NOTE: XFP-10G-CBAND-T50-ZR is supported in Junos OS Release 10.2 and later
	Optical interface specifications—see 10-Gigabit Ethernet 10GBASE Optical Interface Specifications

LEDs	**OK/FAIL** LED, one bicolor: • Steady green—DPC is functioning normally. • Blinking green—DPC is transitioning online or offline. • Red—DPC has failed. **TUNNEL** LED, one green per port: • Off—Normal operating mode. • On steadily—Port configured in tunnel mode. **LINK** LED, one green per port: • Off—No link. • On steadily—Link is active. The **TUNNEL** and **LINK** LEDs are labeled top to bottom: • 2-port: **0/0** through **1/0** • 4-port: **0/0** through **3/0**

Related Documentation

- MX Series DPC Overview on page 4
- DPCs Supported on MX240, MX480, and MX960 Routers on page 6
- 10-Gigabit Ethernet 10GBASE Optical Interface Specifications

10-Gigabit Ethernet Enhanced Ethernet Services DPC with XFP



Software release	• Junos OS Release 8.4 and later
Description	• Four 10-Gigabit Ethernet ports • Power requirement: 6.46 A @ 48 V (310 W) • Weight: 13.1 lb (5.9 kg) • Model number: DPCE-X-4XGE-XFP
Hardware features	• High-performance throughput on each port at speeds up to 10 Gbps • WAN-PHY mode at 9.953 Gbps • LAN-PHY mode at 10.3125 Gbps • Full-duplex mode • Maximum transmission units (MTUs) of up to 9192 bytes • Enhanced ASICs for increased performance and scalability of Layer 2 features
Software features	• Configurable WAN-PHY mode options • See "Protocols and Applications Supported by Enhanced Ethernet Services DPCs (DPCE-X)" on page 56 for information about the protocols and applications that this DPC supports. NOTE: The routing table is limited to 32,000 IP routes. This limitation applies to any manner in which the routes are learned, such as OSPF, RIP, and so on. The DPC supports BGP for L2 VPNs only.

Cables and connectors

- You can install any transceiver supported by the DPC. For information about installing and removing transceivers, see the hardware guide for your router.
- Fiber-optic 10-gigabit small form-factor pluggable (XFP) transceivers:
  - Connector: Duplex LC/PC (Rx and Tx)
  - 10GBASE-E (model number: XFP-10G-E-OC192-IR2)
  - 10GBASE-L (model number: XFP-10G-L-OC192-SR1)
  - 10GBASE-S (model number: XFP-10G-S)
  - 10GBASE-Z (model number: XFP-10G-Z-OC192-LR2)

  Optical interface specifications—see 10-Gigabit Ethernet 10GBASE Optical Interface Specifications
- DWDM Tunable XFP transceivers:
  - Connector: Duplex LC/PC (Rx and Tx)
  - 10GBASE-ZR (model number: XFP-10G-CBAND-T50-ZR)
    DWDM supported wavelengths—see 10-Gigabit Ethernet DWDM Transceiver Wavelengths

NOTE: XFP-10G-CBAND-T50-ZR is supported in Junos OS Release 10.2 and later

Optical interface specifications—see 10-Gigabit Ethernet 10GBASE Optical Interface Specifications

LEDs

OK/FAIL LED, one bicolor:

- Steady green—DPC is functioning normally.
- Blinking green—DPC is transitioning online or offline.
- Red—DPC has failed.

TUNNEL LED, one green per port:

- Off—Normal operating mode.
- On steadily—Port configured in tunnel mode.

LINK LED, one green per port:

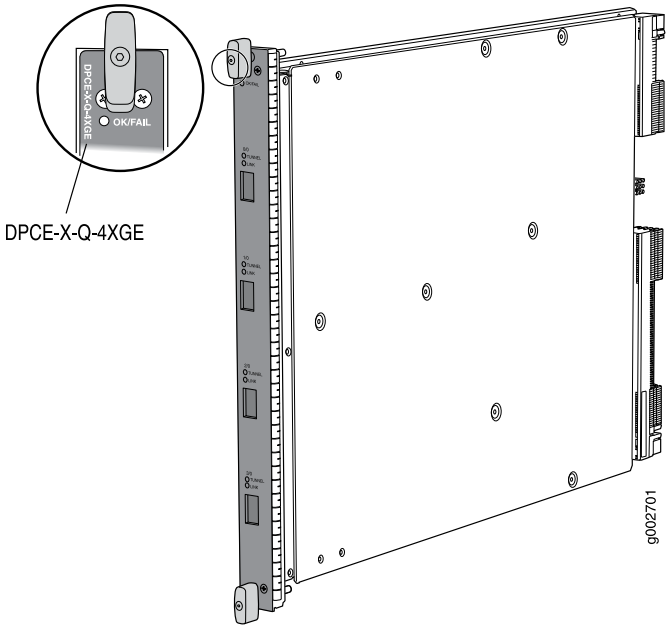
- Off—No link.
- On steadily—Link is active.

The **TUNNEL** and **LINK** LEDs are labeled top to bottom **0/0** through **3/0**.

Related Documentation

- MX Series DPC Overview on page 4
- DPCs Supported on MX240, MX480, and MX960 Routers on page 6
- 10-Gigabit Ethernet 10GBASE Optical Interface Specifications

10-Gigabit Ethernet Enhanced Queuing Ethernet Services DPC with XFP

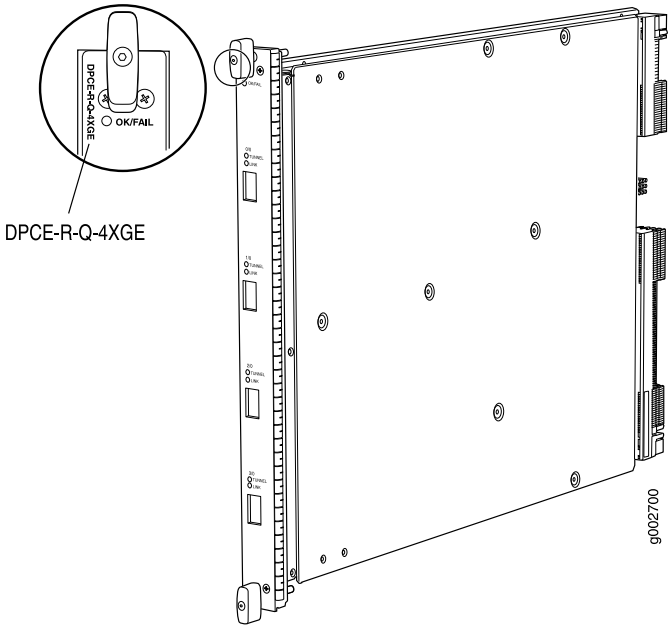


Software release	• Junos OS Release 8.5 and later
Description	• Four 10-Gigabit Ethernet ports • Power requirement: 6.87 A @ 48 V (330 W) • Weight: 13.1 lb (5.9 kg) • Model number: DPCE-X-Q-4XGE-XFP
Hardware features	• High-performance throughput on each port at speeds up to 10 Gbps • WAN-PHY mode at 9.953 Gbps • LAN-PHY mode at 10.3125 Gbps • Full-duplex mode • Maximum transmission units (MTUs) of up to 9192 bytes • Enhanced ASICs for increased performance and scalability of Layer 2 features
Software features	• Configurable WAN-PHY mode options • See "Protocols and Applications Supported by Enhanced Queuing Ethernet Services DPCs (DPCE-X-Q)" on page 66 for information about the protocols and applications that this DPC supports. NOTE: The routing table is limited to 32,000 IP routes. This limitation applies to any manner in which the routes are learned, such as OSPF, RIP, and so on. The DPC supports BGP for L2 VPNs only.

Cables and connectors	• You can install any transceiver supported by the DPC. For information about installing and removing transceivers, see the hardware guide for your router.
	• Fiber-optic 10-gigabit small form-factor pluggable (XFP) transceivers:
	  • Connector: Duplex LC/PC (Rx and Tx)
	  • 10GBASE-E (model number: XFP-10G-E-OC192-IR2)
	  • 10GBASE-L (model number: XFP-10G-L-OC192-SR1)
	  • 10GBASE-S (model number: XFP-10G-S)
	  • 10GBASE-Z (model number: XFP-10G-Z-OC192-LR2)
	  Optical interface specifications—see 10-Gigabit Ethernet 10GBASE Optical Interface Specifications
	• DWDM Tunable XFP transceivers:
	  • Connector: Duplex LC/PC (Rx and Tx)
	  • 10GBASE-ZR (model number: XFP-10G-CBAND-T50-ZR)
	  DWDM supported wavelengths—see 10-Gigabit Ethernet DWDM Transceiver Wavelengths
	NOTE: XFP-10G-CBAND-T50-ZR is supported in Junos OS Release 10.2 and later
	Optical interface specifications—see 10-Gigabit Ethernet 10GBASE Optical Interface Specifications

LEDs	**OK/FAIL** LED, one bicolor: • Steady green—DPC is functioning normally. • Blinking green—DPC is transitioning online or offline. • Red—DPC has failed. **TUNNEL** LED, one green per port: • Off—Normal operating mode. • On steadily—Port configured in tunnel mode. **LINK** LED, one green per port: • Off—No link. • On steadily—Link is active. The **TUNNEL** and **LINK** LEDs are labeled top to bottom **0/0** through **3/0**.
Related Documentation	• MX Series DPC Overview on page 4 • DPCs Supported on MX240, MX480, and MX960 Routers on page 6 • 10-Gigabit Ethernet 10GBASE Optical Interface Specifications

10-Gigabit Ethernet Enhanced Queuing IP Services DPC with XFP



Software release	• Junos OS Release 8.5 and later
Description	• Four 10-Gigabit Ethernet ports • Power requirement: 6.87 A @ 48 V (330 W) • Weight: 13.1 lb (5.9 kg) • Model number: DPCE-R-Q-4XGE-XFP
Hardware features	• High-performance throughput on each port at speeds up to 10 Gbps • WAN-PHY mode at 9.953 Gbps • LAN-PHY mode at 10.3125 Gbps • Full-duplex mode • Maximum transmission units (MTUs) of up to 9192 bytes • Enhanced ASICs for increased performance and scalability of Layer 2 features
Software features	• Configurable WAN-PHY mode options • See "Protocols and Applications Supported by Enhanced Queuing IP Services DPCs (DPCE-R-Q)" on page 61 for information about the protocols and applications that this DPC supports.

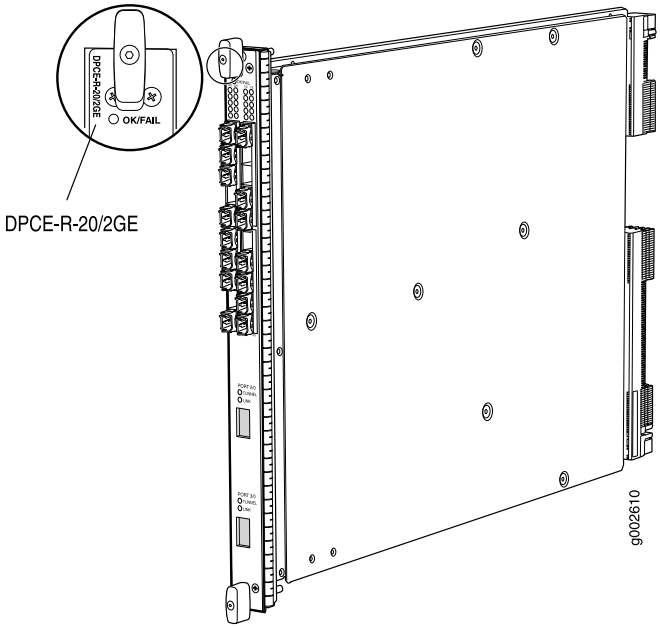
Cables and connectors	• You can install any transceiver supported by the DPC. For information about installing and removing transceivers, see the hardware guide for your router.
	• Fiber-optic 10-gigabit small form-factor pluggable (XFP) transceivers:
	  • Connector: Duplex LC/PC (Rx and Tx)
	  • 10GBASE-E (model number: XFP-10G-E-OC192-IR2)
	  • 10GBASE-L (model number: XFP-10G-L-OC192-SR1)
	  • 10GBASE-S (model number: XFP-10G-S)
	  • 10GBASE-Z (model number: XFP-10G-Z-OC192-LR2)
	  Optical interface specifications—see 10-Gigabit Ethernet 10GBASE Optical Interface Specifications
	• DWDM Tunable XFP transceivers:
	  • Connector: Duplex LC/PC (Rx and Tx)
	  • 10GBASE-ZR (model number: XFP-10G-CBAND-T50-ZR)
	  DWDM supported wavelengths—see 10-Gigabit Ethernet DWDM Transceiver Wavelengths
	NOTE: XFP-10G-CBAND-T50-ZR is supported in Junos OS Release 10.2 and later
	Optical interface specifications—see 10-Gigabit Ethernet 10GBASE Optical Interface Specifications

LEDs	**OK/FAIL** LED, one bicolor: • Steady green—DPC is functioning normally. • Blinking green—DPC is transitioning online or offline. • Red—DPC has failed. **TUNNEL** LED, one green per port: • Off—Normal operating mode. • On steadily—Port configured in tunnel mode. **LINK** LED, one green per port: • Off—No link. • On steadily—Link is active. The **TUNNEL** and **LINK** LEDs are labeled top to bottom **0/0** through **3/0**.

Related Documentation

- MX Series DPC Overview on page 4
- DPCs Supported on MX240, MX480, and MX960 Routers on page 6
- 10-Gigabit Ethernet 10GBASE Optical Interface Specifications

Multi-Rate Ethernet Enhanced DPC with SFP and XFP



Software release	• Junos OS Release 9.2 and later
Description	• 20 Gigabit Ethernet ports • 2 10-Gigabit Ethernet ports • Power requirement: 6.94 A @ 48 V (333 W) • Weight: 13.1 lb (5.9 kg) • Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network • Model number: DPCE-R-20GE-2XGE

Hardware features	• SFP ports:
	  ◦ High-performance throughput on each port at speeds up to 1 Gbps
	• XFP ports:
	  ◦ High-performance throughput on each port at speeds up to 10 Gbps
	  ◦ WAN-PHY mode at 9.953 Gbps
	  ◦ LAN-PHY mode at 10.3125 Gbps
	• Autonegotiation between Gigabit Ethernet circuit partners
	• Full-duplex mode
	• Maximum transmission units (MTUs) of up to 9192 bytes
	• Enhanced ASICs for increased performance and scalability of Layer 2 features

Software features	• Configurable WAN-PHY mode options • Optical diagnostics and related alarms • See "Protocols and Applications Supported by DPCs and Enhanced DPCs (DPC and DPCE-R)" on page 49 for information about the protocols and applications that this DPC supports.

Cables and connectors

- You can install any transceiver supported by the DPC. For information about installing and removing transceivers, see the hardware guide for your router.
- Fiber-optic small form-factor pluggable (SFP) transceivers:
  - Connector: Duplex LC/PC (Rx and Tx)
  - 100BASE-FX (model number: SFP-1FE-FX) supported in Junos OS Release 9.3 and later
  - 1000BASE-EX (model number: SFP-GE40KM)
  - 1000BASE-LH (model number: SFP-1GE-LH)
  - 1000BASE-LX (model number: SFP-1GE-LX)
  - 1000BASE-SX (model number: SFP-1GE-SX)

  Optical interface specifications—see Gigabit Ethernet 1000BASE Optical Interface Specifications
- Copper SFP transceivers:
  - Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
  - 1000BASE-T (model number: SFP-1GE-T)
  - 10/100/1000BASE-T (model number: SFP-1GE-FE-E-T)

  NOTE: SFP-1GE-FE-E-T supports tri-rate 10/100/1000 mode in Junos OS Release 9.4 and later

  - Pinout: MDI, MDI crossover
  - Length: 328 ft/100 m

  Copper interface specifications—see Ethernet 10BASE-T Copper Interface Specifications, Fast Ethernet 100BASE-T Copper Interface Specifications, and Gigabit Ethernet 1000BASE-T Copper Interface Specifications
- Bidirectional SFP transceivers:
  - Connector: Duplex LC/PC (Rx and Tx)
  - 100BASE-BX (model number pairs: EX-SFP-FE20KT13R15 with EX-SFP-FE20KT15R13)
  - 1000BASE-BX (model number pairs: SFP-GE10KT13R14 with SFP-GE10KT14R13, SFP-GE10KT13R15 with SFP-GE10KT15R13, SFP-GE40KT13R15 with SFP-GE40KT15R13)

  Optical interface specifications—see Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications
- Fiber-optic 10-gigabit small form-factor pluggable (XFP) transceivers:
  - Connector: Duplex LC/PC (Rx and Tx)
  - 10GBASE-E (model number: XFP-10G-E-OC192-IR2)
  - 10GBASE-L (model number: XFP-10G-L-OC192-SR1)
  - 10GBASE-S (model number: XFP-10G-S)
  - 10GBASE-Z (model number: XFP-10G-Z-OC192-LR2)

  Optical interface specifications—see 10-Gigabit Ethernet 10GBASE Optical Interface Specifications
- DWDM Tunable XFP transceivers:
  - Connector: Duplex LC/PC (Rx and Tx)
  - 10GBASE-ZR (model number: XFP-10G-CBAND-T50-ZR)
    DWDM supported wavelengths—see 10-Gigabit Ethernet DWDM Transceiver Wavelengths

  NOTE: XFP-10G-CBAND-T50-ZR is supported in Junos OS Release 10.2 and later

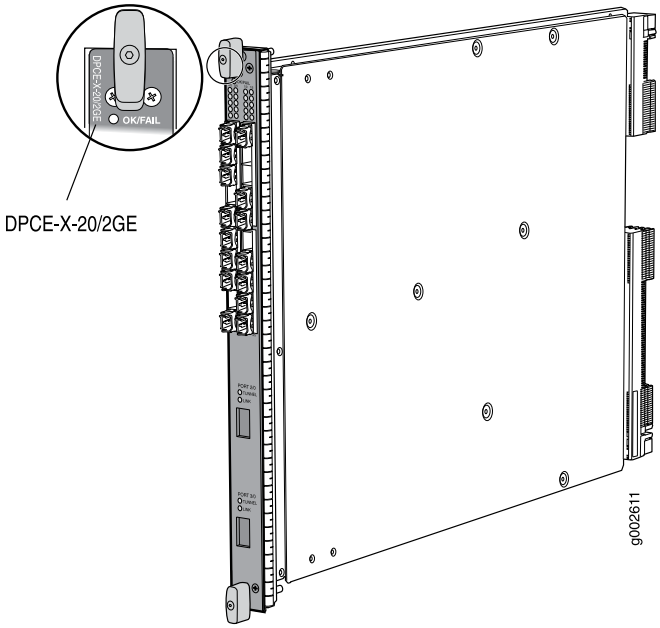
  Optical interface specifications—see 10-Gigabit Ethernet 10GBASE Optical Interface Specifications

LEDs	**OK/FAIL** LED, one bicolor: • Steady green—DPC is functioning normally. • Blinking green—DPC is transitioning online or offline. • Red—DPC has failed. **LINK** LED, one green per port: • Off—No link. • On steadily—Link is active. **TUNNEL** LED, one green per XFP port: • Off—Normal operating mode. • On steadily—Port configured in tunnel mode. The SFP Link LEDs are labeled in groups of five: • **0/0** for **0/0** through **0/4** • **0/5** for **0/5** through **0/9** • **1/0** for **1/0** through **1/4** • **1/5** for **1/5** through **1/9** The XFP ports are labeled top to bottom **2/0** and **3/0**.

Related Documentation

- MX Series DPC Overview on page 4
- DPCs Supported on MX240, MX480, and MX960 Routers on page 6
- Gigabit Ethernet 1000BASE Optical Interface Specifications
- Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications
- 10-Gigabit Ethernet 10GBASE Optical Interface Specifications

Multi-Rate Ethernet Enhanced Ethernet Services DPC with SFP and XFP



Software release	• Junos OS Release 9.2 and later
Description	• 20 Gigabit Ethernet ports • 2 10-Gigabit Ethernet ports • Power requirement: 6.94 A @ 48 V (333 W) • Weight: 13.1 lb (5.9 kg) • Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network • Model number: DPCE-X-20GE-2XGE

Hardware features	• SFP ports:
	  ◦ High-performance throughput on each port at speeds up to 1 Gbps
	• XFP ports:
	  ◦ High-performance throughput on each port at speeds up to 10 Gbps
	  ◦ WAN-PHY mode at 9.953 Gbps
	  ◦ LAN-PHY mode at 10.3125 Gbps
	• Full-duplex mode
	• Maximum transmission units (MTUs) of up to 9192 bytes
	• Enhanced ASICs for increased performance and scalability of Layer 2 features

Software features	• Configurable WAN-PHY mode options • Optical diagnostics and related alarms • See "Protocols and Applications Supported by Enhanced Ethernet Services DPCs (DPCE-X)" on page 56 for information about the protocols and applications that this DPC supports.

Cables and connectors

- You can install any transceiver supported by the DPC. For information about installing and removing transceivers, see the hardware guide for your router.
- Fiber-optic small form-factor pluggable (SFP) transceivers:
  - Connector: Duplex LC/PC (Rx and Tx)
  - 100BASE-FX (model number: SFP-1FE-FX) supported in Junos OS Release 9.3 and later
  - 1000BASE-EX (model number: SFP-GE40KM)
  - 1000BASE-LH (model number: SFP-1GE-LH)
  - 1000BASE-LX (model number: SFP-1GE-LX)
  - 1000BASE-SX (model number: SFP-1GE-SX)

  Optical interface specifications—see Gigabit Ethernet 1000BASE Optical Interface Specifications
- Copper SFP transceivers:
  - Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
  - 1000BASE-T (model number: SFP-1GE-T)
  - 10/100/1000BASE-T (model number: SFP-1GE-FE-E-T)

  NOTE: SFP-1GE-FE-E-T supports tri-rate 10/100/1000 mode in Junos OS Release 9.4 and later
  - Pinout: MDI, MDI crossover
  - Length: 328 ft/100 m

  Copper interface specifications—see Ethernet 10BASE-T Copper Interface Specifications, Fast Ethernet 100BASE-T Copper Interface Specifications, and Gigabit Ethernet 1000BASE-T Copper Interface Specifications
- Bidirectional SFP transceivers:
  - Connector: Duplex LC/PC (Rx and Tx)
  - 100BASE-BX (model number pairs: EX-SFP-FE20KT13R15 with EX-SFP-FE20KT15R13)
  - 1000BASE-BX (model number pairs: SFP-GE10KT13R14 with SFP-GE10KT14R13, SFP-GE10KT13R15 with SFP-GE10KT15R13, SFP-GE40KT13R15 with SFP-GE40KT15R13)

  Optical interface specifications—see Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications
- Fiber-optic 10-gigabit small form-factor pluggable (XFP) transceivers:
  - Connector: Duplex LC/PC (Rx and Tx)
  - 10GBASE-E (model number: XFP-10G-E-OC192-IR2)
  - 10GBASE-L (model number: XFP-10G-L-OC192-SR1)
  - 10GBASE-S (model number: XFP-10G-S)
  - 10GBASE-Z (model number: XFP-10G-Z-OC192-LR2)

  Optical interface specifications—see 10-Gigabit Ethernet 10GBASE Optical Interface Specifications
- DWDM Tunable XFP transceivers:
  - Connector: Duplex LC/PC (Rx and Tx)
  - 10GBASE-ZR (model number: XFP-10G-CBAND-T50-ZR)
    DWDM supported wavelengths—see 10-Gigabit Ethernet DWDM Transceiver Wavelengths

  NOTE: XFP-10G-CBAND-T50-ZR is supported in Junos OS Release 10.2 and later

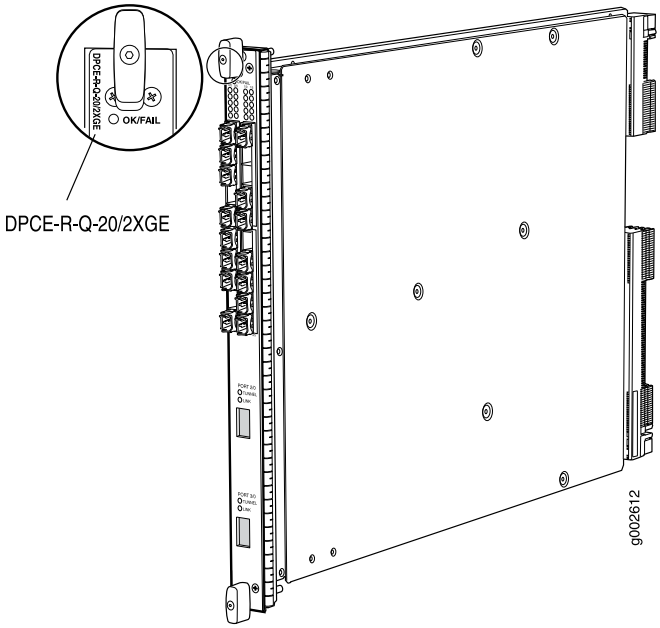
  Optical interface specifications—see 10-Gigabit Ethernet 10GBASE Optical Interface Specifications

LEDs	**OK/FAIL** LED, one bicolor: • Steady green—DPC is functioning normally. • Blinking green—DPC is transitioning online or offline. • Red—DPC has failed. **LINK** LED, one green per port: • Off—No link. • On steadily—Link is active. **TUNNEL** LED, one green per XFP port: • Off—Normal operating mode. • On steadily—Port configured in tunnel mode. The SFP Link LEDs are labeled in groups of five: • **0/0** for **0/0** through **0/4** • **0/5** for **0/5** through **0/9** • **1/0** for **1/0** through **1/4** • **1/5** for **1/5** through **1/9** The XFP ports are labeled top to bottom **2/0** and **3/0**.

Related Documentation

- MX Series DPC Overview on page 4
- DPCs Supported on MX240, MX480, and MX960 Routers on page 6
- Gigabit Ethernet 1000BASE Optical Interface Specifications
- Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications
- 10-Gigabit Ethernet 10GBASE Optical Interface Specifications

Multi-Rate Ethernet Enhanced Queuing IP Services DPC with SFP and XFP



Software release	• Junos OS Release 9.3 and later
Description	• 20 Gigabit Ethernet ports • 2 10-Gigabit Ethernet ports • Power requirement: 6.98 A @ 48 V (335 W) • Weight: 13.1 lb (5.9 kg) • Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network • Model number: DPCE-R-Q-20GE-2XGE

Hardware features	• SFP ports:
	  ◦ High-performance throughput on each port at speeds up to 1 Gbps
	• XFP ports:
	  ◦ High-performance throughput on each port at speeds up to 10 Gbps
	  ◦ WAN-PHY mode at 9.953 Gbps
	  ◦ LAN-PHY mode at 10.3125 Gbps
	• Full-duplex mode
	• Maximum transmission units (MTUs) of up to 9192 bytes
	• Enhanced ASICs for increased performance and scalability of Layer 2 features

Software features	• Configurable WAN-PHY mode options • Optical diagnostics and related alarms • See "Protocols and Applications Supported by Enhanced Queuing IP Services DPCs (DPCE-R-Q)" on page 61 for information about the protocols and applications that this DPC supports.

Cables and connectors

- You can install any transceiver supported by the DPC. For information about installing and removing transceivers, see the hardware guide for your router.
- Fiber-optic small form-factor pluggable (SFP) transceivers:
  - Connector: Duplex LC/PC (Rx and Tx)
  - 100BASE-FX (model number: SFP-1FE-FX) supported in Junos OS Release 9.3 and later
  - 1000BASE-EX (model number: SFP-GE40KM)
  - 1000BASE-LH (model number: SFP-1GE-LH)
  - 1000BASE-LX (model number: SFP-1GE-LX)
  - 1000BASE-SX (model number: SFP-1GE-SX)

  Optical interface specifications—see Gigabit Ethernet 1000BASE Optical Interface Specifications
- Copper SFP transceivers:
  - Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
  - 1000BASE-T (model number: SFP-1GE-T)
  - 10/100/1000BASE-T (model number: SFP-1GE-FE-E-T)

  NOTE: SFP-1GE-FE-E-T supports tri-rate 10/100/1000 mode in Junos OS Release 9.4 and later

  - Pinout: MDI, MDI crossover
  - Length: 328 ft/100 m

  Copper interface specifications—see Ethernet 10BASE-T Copper Interface Specifications, Fast Ethernet 100BASE-T Copper Interface Specifications, and Gigabit Ethernet 1000BASE-T Copper Interface Specifications
- Bidirectional SFP transceivers:
  - Connector: Duplex LC/PC (Rx and Tx)
  - 100BASE-BX (model number pairs: EX-SFP-FE20KT13R15 with EX-SFP-FE20KT15R13)
  - 1000BASE-BX (model number pairs: SFP-GE10KT13R14 with SFP-GE10KT14R13, SFP-GE10KT13R15 with SFP-GE10KT15R13, SFP-GE40KT13R15 with SFP-GE40KT15R13)

  Optical interface specifications—see Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications
- Fiber-optic 10-gigabit small form-factor pluggable (XFP) transceivers:
  - Connector: Duplex LC/PC (Rx and Tx)
  - 10GBASE-E (model number: XFP-10G-E-OC192-IR2)
  - 10GBASE-L (model number: XFP-10G-L-OC192-SR1)
  - 10GBASE-S (model number: XFP-10G-S)
  - 10GBASE-Z (model number: XFP-10G-Z-OC192-LR2)

  Optical interface specifications—see 10-Gigabit Ethernet 10GBASE Optical Interface Specifications
- DWDM Tunable XFP transceivers:
  - Connector: Duplex LC/PC (Rx and Tx)
  - 10GBASE-ZR (model number: XFP-10G-CBAND-T50-ZR)
    DWDM supported wavelengths—see 10-Gigabit Ethernet DWDM Transceiver Wavelengths

  NOTE: XFP-10G-CBAND-T50-ZR is supported in Junos OS Release 10.2 and later

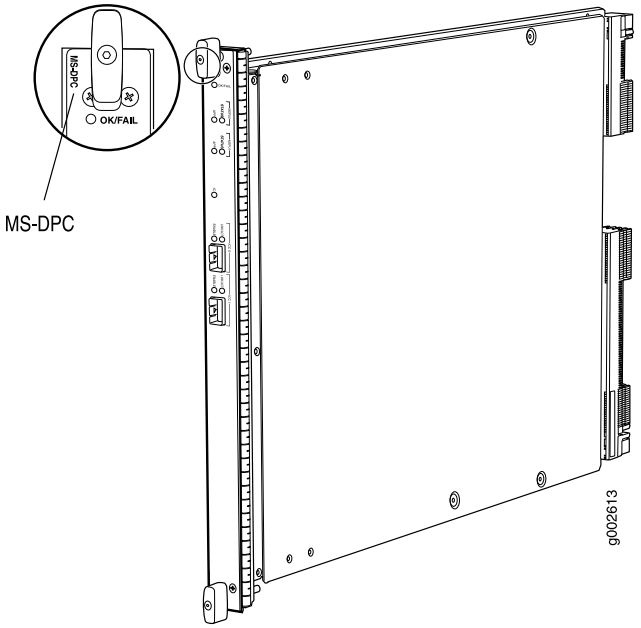
  Optical interface specifications—see 10-Gigabit Ethernet 10GBASE Optical Interface Specifications

LEDs	**OK/FAIL** LED, one bicolor: • Steady green—DPC is functioning normally. • Blinking green—DPC is transitioning online or offline. • Red—DPC has failed. **LINK** LED, one green per port: • Off—No link. • On steadily—Link is active. **TUNNEL** LED, one green per XFP port: • Off—Normal operating mode. • On steadily—Port configured in tunnel mode. The SFP Link LEDs are labeled in groups of five: • **0/0** for **0/0** through **0/4** • **0/5** for **0/5** through **0/9** • **1/0** for **1/0** through **1/4** • **1/5** for **1/5** through **1/9** The XFP ports are labeled top to bottom **2/0** and **3/0**.

Related Documentation

- MX Series DPC Overview on page 4
- DPCs Supported on MX240, MX480, and MX960 Routers on page 6
- Gigabit Ethernet 1000BASE Optical Interface Specifications
- Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications
- 10-Gigabit Ethernet 10GBASE Optical Interface Specifications

Multiservices DPC



Software release	• Junos OS Release 9.3 and later

Description	• Power requirement: 5.52 A @ 48 V (265 W)
	• Weight: 14.7 lb (6.7 kg)
	• Supports tunnel services. This feature is included with the DPC and does not require an individual license.
	• Individual licenses must be purchased for additional services.
	• Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network
	• Maximum number of supported DPCs:
	  ◦ MX240 router: 2
	  ◦ MX480 router: 4
	  ◦ MX960 router: 4
	• Model number: MS-DPC

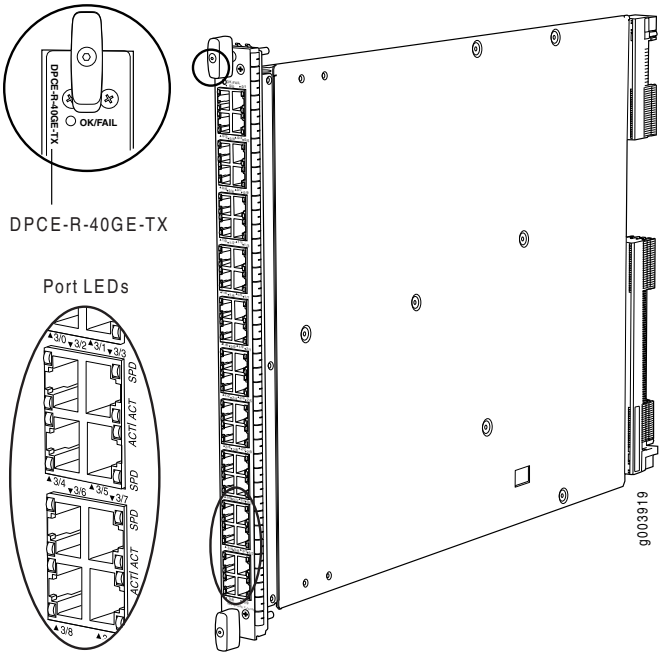
Hardware features	• Active monitoring on up to 10 million flows • Maximum transmission units (MTUs) of up to 9192 bytes • Two Multiservices Processing Units (MSPUs) per DPC, which include two 1.1Ghz multicore CPUs, each with 4GB of memory for processing integrated services
Software features	• Support for up to 12,000 service sets • See "Protocols and Applications Supported by the Multiservices DPC (MS-DPC)" on page 71 for information about the protocols and applications that this DPC supports.
Cables and connectors	• SFPs are not supported.

LEDs	**OK/FAIL** LED, one bicolor: • Steady green—DPC is functioning normally. • Blinking green—DPC is transitioning online or offline. • Red—DPC has failed. **STATUS** LED, one tricolor per MSPU: • Off—MSPU is offline. If both MSPUs are offline it is safe to remove the DPC from the chassis. • Green—MSPU is operating normally. • Yellow—MSPU is initializing. • Red—MSPU has an error or failure. Application (**APP**) LED, one tricolor per MSPU: • Off—Service is not running on the MSPU. • Green—Service is running on the MSPU under acceptable load. • Yellow—Service on the MSPU is overloaded.

Related Documentation

- MX Series DPC Overview on page 4
- DPCs Supported on MX240, MX480, and MX960 Routers on page 6

Tri-Rate Enhanced DPC



Software release	• Junos OS Release 9.1 and later
Description	• 40 autonegotiating 10BASE-T, 100BASE-TX, or 1000BASE-T Megabit Ethernet ports • Power requirement: 6.67 A @ 48 V (320 W) • Weight: 14.5 lb (6.6 kg) • Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network • Model number: DPCE-R-40GE-TX

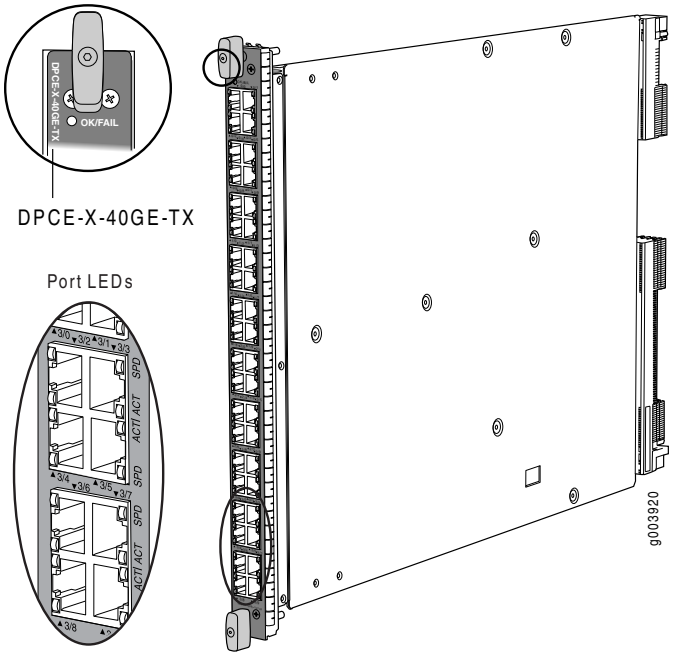
Hardware features	• High-performance throughput on each port at speeds of 10 Mbps, 100 Mbps, or 1000 Mbps
	• Autonegotiation between Gigabit Ethernet circuit partners
	• Full-duplex mode
	• Maximum transmission units (MTUs) of up to 9192 bytes
	• Enhanced ASICs for increased performance and scalability of Layer 2 features
	• The ports are grouped in sets of four and labeled:
	  ◦ 0/0 through 0/9
	  ◦ 1/0 through 1/9
	  ◦ 2/0 through 2/9
	  ◦ 3/0 through 3/9

Software features	• See "Protocols and Applications Supported by DPCs and Enhanced DPCs (DPC and DPCE-R)" on page 49 for information about the protocols and applications that this DPC supports.

Cables and connectors	• Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
	• Pinout:
	  • Junos OS Release 9.1: MDI
	  • Junos OS Release 9.2 and later: MDI, MDI crossover
	• Maximum distance: 328 ft/100 m
	
	CAUTION: Do not use RJ-45 cables with strain-relief boots exceeding 1.5 mm from the bottom of the connector. Cable boots that exceed this measurement can damage the port.

LEDs	**OK/FAIL** LED, one bicolor: • Steady green—DPC is functioning normally. • Blinking green—DPC is transitioning online or offline. • Red—DPC has failed. **ACT** LED, one green per port: • Off—No active traffic. • Blinking—Link is active. **SPD** LED, one bicolor: • Green—DPC is functioning in 1000BASE-T mode. • Yellow—DPC is functioning in 10BASE-T or 100BASE-TX mode. • Off—No link. The **ACT** and **SPD** LEDs are located on either side of the ports labeled horizontally and top to bottom **0/0** through **3/9**.
Related Documentation	• MX Series DPC Overview on page 4 • DPCs Supported on MX240, MX480, and MX960 Routers on page 6

Tri-Rate Enhanced Ethernet Services DPC



Software release	• Junos OS Release 9.1 and later
Description	• 40 autonegotiating 10BASE-T, 100.BASE-TX, or 1000BASE-T Megabit Ethernet ports • Power requirement: 6.67 A @ 48 V (320 W) • Weight: 14.5 lb (6.6 kg) • Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network • Model number: DPCE-X-40GE-TX
Hardware features	• High-performance throughput on each port at speeds of 10 Mbps, 100 Mbps, or 1000 Mbps • Autonegotiation between Gigabit Ethernet circuit partners • Full-duplex mode • Maximum transmission units (MTUs) of up to 9192 bytes • Enhanced ASICs for increased performance and scalability of Layer 2 features
Software features	• See "Protocols and Applications Supported by Enhanced Ethernet Services DPCs (DPCE-X)" on page 56 for information about the protocols and applications that this DPC supports.

Cables and connectors	• Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
	• Pinout:
	  • Junos OS Release 9.1: MDI
	  • Junos OS Release 9.2 and later: MDI, MDI crossover
	• Maximum distance: 328 ft/100 m
	
	CAUTION: Do not use RJ-45 cables with strain-relief boots exceeding 1.5 mm from the bottom of the connector. Cable boots that exceed this measurement can damage the port.

LEDs	**OK/FAIL** LED, one bicolor: • Steady green—DPC is functioning normally. • Blinking green—DPC is transitioning online or offline. • Red—DPC has failed. **ACT** LED, one green per port: • Off—No active traffic. • Blinking—Link is active. **SPD** LED, one bicolor: • Green—DPC is functioning in 1000BASE-T mode. • Yellow—DPC is functioning in 10BASE-T or 100BASE-TX mode. • Off—No link. The **ACT** and **SPD** LEDs are located on either side of the ports labeled horizontally and top to bottom **0/0** through **3/9**.

Related Documentation

- MX Series DPC Overview on page 4
- DPCs Supported on MX240, MX480, and MX960 Routers on page 6

MX240, MX480, and MX960 DPC Protocol and Application Support

Protocols and Applications Supported by DPCs and Enhanced DPCs (DPC and DPCE-R)

Table 2 on page 49 contains the first Junos OS Release support for protocols and applications on the MX240, MX480, and MX960 DPCs and Enhanced DPCs. A dash indicates that the protocol or application is not supported.

Table 2: Protocols and Applications Supported by the DPCs and Enhanced DPCs (DPC and DPCE-R)

Protocol or Application	First Junos OS Release Supported by DPC Model Number (DPC Name)				
	DPC-R-4XGE-XFP DPC-R-40GE-SFP (DPC)	DPCE-R-2XGE-XFP (Enhanced DPC)	DPCE-R-4XGE-XFP DPCE-R-40GE-SFP (Enhanced DPC)	DPCE-R-40GE-TX (Tri-Rate Enhanced DPC)	DPCE-R-20GE-2XGE (Multi-Rate Enhanced DPC)
Access Node Control Protocol (ANCP)	9.4	9.4	9.4	9.4	9.4
Accepts traffic destined for GRE tunnels or DVMRP (IP-in-IP) tunnels	8.2	9.1	8.4	9.1	9.2
Bidirectional Forwarding Detection protocol (BFD)	8.2	9.1	8.4	9.1	9.2
Border Gateway Protocol (BGP)	8.2	9.1	8.4	9.1	9.2
BGP/Multiprotocol Label Switching (MPLS) virtual private networks (VPNs)	8.2	9.1	8.4	9.1	9.2

Table 2: Protocols and Applications Supported by the DPCs and Enhanced DPCs (DPC and DPCE-R) *(continued)*

Protocol or Application	First Junos OS Release Supported by DPC Model Number (DPC Name)				
	DPC-R-4XGE-XFP DPC-R-40GE-SFP (DPC)	DPCE-R-2XGE-XFP (Enhanced DPC)	DPCE-R-4XGE-XFP DPCE-R-40GE-SFP (Enhanced DPC)	DPCE-R-40GE-TX (Tri-Rate Enhanced DPC)	DPCE-R-20GE-2XGE (Multi-Rate Enhanced DPC)
Distance Vector Multicast Routing Protocol (DVMRP) and generic routing encapsulation (GRE) support—access side and server side	8.2	9.1	8.4	9.1	9.2
IEEE 802.1ag Ethernet OAM Continuity Check protocol	8.4	9.1	8.4	9.1	9.2
IEEE 802.1ag Ethernet OAM Linktrace protocol	9.0	9.1	9.0	9.1	9.2
IEEE 802.1ag Ethernet OAM Loopback protocol	9.1	9.1	9.1	9.1	9.2
Firewall filters	8.2	9.1	8.4	9.1	9.2
Flexible Ethernet encapsulation	8.2	9.1	8.4	9.1	9.2
Graceful Routing Engine Switchover (GRES)	8.3	9.1	8.4	9.1	9.2
In-service software upgrade (ISSU) (excludes IEEE 802.1ag OAM, IEEE 802.3ah, and LACP protocols)	9.3	9.3	9.3	9.3	9.3
Ingress hierarchical quality of service (HQoS) shaping and hierarchical-scheduler: • Group of virtual LANs (VLANs) level • Virtual LAN (VLAN) level • Port level	–	–	–	–	–
IPv4	8.2	9.1	8.4	9.1	9.2

Table 2: Protocols and Applications Supported by the DPCs and Enhanced DPCs (DPC and DPCE-R) *(continued)*

Protocol or Application	First Junos OS Release Supported by DPC Model Number (DPC Name)				
	DPC-R-4XGE-XFP DPC-R-40GE-SFP (DPC)	DPCE-R-2XGE-XFP (Enhanced DPC)	DPCE-R-4XGE-XFP DPCE-R-40GE-SFP (Enhanced DPC)	DPCE-R-40GE-TX (Tri-Rate Enhanced DPC)	DPCE-R-20GE-2XGE (Multi-Rate Enhanced DPC)
IP multicast	8.2	9.1	8.4	9.1	9.2
IPv6	8.2	9.1	8.4	9.1	9.2
IPv6 multicast	8.2	9.1	8.4	9.1	9.2
IPv6 Neighbor Discovery	8.2	9.1	8.4	9.1	9.2
Intermediate System-to-Intermediate System (IS-IS)	8.2	9.1	8.4	9.1	9.2
Layer 2 frame filtering	8.2	9.1	8.4	9.1	9.2
IEEE 802.3ad link aggregation	8.2	9.1	8.4	9.1	9.2
Link Aggregation Control Protocol (LACP)	8.2	9.1	8.4	9.1	9.2
Local loopback	8.2	9.1	8.4	9.1	9.2
MAC learning, policing, accounting, and filtering	8.2	9.1	8.4	9.1	9.2
Mobile IP	9.3	9.3	9.3	9.3	9.3
IEEE 802.1s Multiple Spanning Tree Protocol (MSTP) (part of IEEE 802.1Q VLANs)	8.4	9.1	8.4	9.1	9.2
Multi-chassis link aggregation (MC-AE)	10.0	10.0	10.0	10.0	10.0
Multiple tag protocol identifiers (TPIDs)	8.2	9.1	8.4	9.1	9.2
Multiprotocol Label Switching (MPLS)	8.2	9.1	8.4	9.1	9.2

Table 2: Protocols and Applications Supported by the DPCs and Enhanced DPCs (DPC and DPCE-R) *(continued)*

Protocol or Application	First Junos OS Release Supported by DPC Model Number (DPC Name)				
	DPC-R-4XGE-XFP DPC-R-40GE-SFP (DPC)	DPCE-R-2XGE-XFP (Enhanced DPC)	DPCE-R-4XGE-XFP DPCE-R-40GE-SFP (Enhanced DPC)	DPCE-R-40GE-TX (Tri-Rate Enhanced DPC)	DPCE-R-20GE-2XGE (Multi-Rate Enhanced DPC)
IEEE 802.1ak-2007 Multiple VLAN Registration Protocol (MVRP)	10.1	10.1	10.1	10.1	10.1
IEEE 802.3ah OAM • Discovery and link monitoring • Fault signaling and detection • Remote loopback	8.2	9.1	8.4	9.1	9.2
Multitopology Routing (MTR)	9.0	9.1	9.0	9.1	9.2
Open Shortest Path First (OSPF)	8.2	9.1	8.4	9.1	9.2
Packet mirroring	8.2	9.1	8.4	9.1	9.2
IEEE 802.1ah provider backbone bridges (PBB)	10.0	10.0	10.0	10.0	10.0
Quality of service (QoS) per port: • 8 queues per port • Shaping at queue level • Scheduling of queues based on weighted round-robin (WRR) per priority class • Random early detection (RED) • Weighted random early detection (WRED)	8.2	9.1	8.4	9.1	9.2
• Shaping at port level	–	–	–	–	–

Table 2: Protocols and Applications Supported by the DPCs and Enhanced DPCs (DPC and DPCE-R) *(continued)*

Protocol or Application	First Junos OS Release Supported by DPC Model Number (DPC Name)				
	DPC-R-4XGE-XFP DPC-R-40GE-SFP (DPC)	DPCE-R-2XGE-XFP (Enhanced DPC)	DPCE-R-4XGE-XFP DPCE-R-40GE-SFP (Enhanced DPC)	DPCE-R-40GE-TX (Tri-Rate Enhanced DPC)	DPCE-R-20GE-2XGE (Multi-Rate Enhanced DPC)
Quality of service (QoS) per virtual LAN (VLAN): • Accounting, filtering, and policing • IEEE 802.1p rewrite • Classification • Tricolor marking	8.2	9.1	8.4	9.1	9.2
Quality of service (QoS) queuing per virtual LAN (VLAN)	–	–	–	–	–
IEEE 802.1w Rapid Spanning Tree Protocol (RSTP)	8.4	9.1	8.4	9.1	9.2
Per-VLAN Spanning Tree (PVST)+	9.0	9.1	9.0	9.1	9.2
RSVP	8.2	9.1	8.4	9.1	9.2
Routing Information Protocol (RIP)	8.2	9.1	8.4	9.1	9.2
SNMP	8.2	9.1	8.4	9.1	9.2
IEEE 802.1D Spanning Tree Protocol (STP)	8.4	9.1	8.4	9.1	9.2
Subscriber Management:	9.4	9.4	9.4	9.4	9.4
• Access Node Control Protocol (ANCP)	9.4	9.4	9.4	9.4	9.4
• Dynamic profiles	9.2	9.2	9.2	9.2	9.2
• Dynamic VLANs	–	9.5	9.5	9.5	9.5

Table 2: Protocols and Applications Supported by the DPCs and Enhanced DPCs (DPC and DPCE-R) *(continued)*

Protocol or Application	First Junos OS Release Supported by DPC Model Number (DPC Name)				
	DPC-R-4XGE-XFP DPC-R-40GE-SFP (DPC)	DPCE-R-2XGE-XFP (Enhanced DPC)	DPCE-R-4XGE-XFP DPCE-R-40GE-SFP (Enhanced DPC)	DPCE-R-40GE-TX (Tri-Rate Enhanced DPC)	DPCE-R-20GE-2XGE (Multi-Rate Enhanced DPC)
• Enhanced Dynamic Host Configuration Protocol (DHCP) local server	9.3	9.3	9.3	9.3	9.3
• Enhanced DCHP relay	9.3	9.3	9.3	9.3	9.3
• Firewall filters	9.2	9.2	9.2	9.2	9.2
• Internet Group Management Protocol (IGMP)	9.2	9.2	9.2	9.2	9.2
• Mobile IP	9.3	9.3	9.3	9.3	9.3
• QoS	9.2	9.2	9.2	9.2	9.2
• Subscriber Secure Policy	9.4	9.4	9.4	9.4	9.4
Two-Way Active Measurement Protocol (TWAMP)	9.5	9.5	9.5	9.5	9.5
IEEE 802.1Q VLANs: • VLAN stacking and rewriting • Channels defined by two stacked VLAN tags • Flexible VLAN tagging • IP service for nonstandard TPID and stacked VLAN tags	8.2	9.1	8.4	9.1	9.2
Virtual private LAN service (VPLS)	8.2	9.1	8.4	9.1	9.2
Virtual private network (VPN)	8.2	9.1	8.4	9.1	9.2
Virtual Router Redundancy Protocol (VRRP) for IPv4	8.2	9.1	8.4	9.1	9.2

Related Documentation

- DPCs Supported on MX240, MX480, and MX960 Routers on page 6
- Protocols and Applications Supported by Enhanced Ethernet Services DPCs (DPCE-X) on page 56
- Protocols and Applications Supported by Enhanced Queuing IP Services DPCs (DPCE-R-Q) on page 61
- Protocols and Applications Supported by Enhanced Queuing Ethernet Services DPCs (DPCE-X-Q) on page 66
- Protocols and Applications Supported by the Multiservices DPC (MS-DPC) on page 71

Protocols and Applications Supported by Enhanced Ethernet Services DPCs (DPCE-X)

Table 3 on page 56 contains the first Junos OS Release support for protocols and applications on the MX240, MX480, and MX960 Enhanced Ethernet Services DPCs. A dash indicates that the protocol or application is not supported.

Table 3: Protocols and Applications Supported by the Enhanced Ethernet Services DPCs (DPCE-X)

Protocol or Application	First Junos OS Release Supported by DPC Model Number (DPC Name)		
	DPCE-X-4XGE-XFP DPCE-X-40GE-SFP (Enhanced Ethernet Services DPC)	DPCE-X-40GE-TX (Tri-Rate Enhanced Ethernet Services DPC)	DPCE-X-20GE-2XGE (Multi-Rate Enhanced Ethernet Services DPC)
Access Node Control Protocol (ANCP)	9.4	9.4	9.4
Accepts traffic destined for GRE tunnels or DVMRP (IP-in-IP) tunnels	8.4	9.1	9.2
Bidirectional Forwarding Detection protocol (BFD)	8.4	9.1	9.2
Border Gateway Protocol (BGP)	8.4	9.1	9.2
BGP/Multiprotocol Label Switching (MPLS) virtual private networks (VPNs)	8.4	9.1	9.2
Distance Vector Multicast Routing Protocol (DVMRP) and generic routing encapsulation (GRE) support—access side and server side	8.4	9.1	9.2
IEEE 802.1ag Ethernet OAM Continuity Check protocol	8.4	9.1	9.2
IEEE 802.1ag Ethernet OAM Linktrace protocol	9.0	9.1	9.2
IEEE 802.1ag Ethernet OAM Loopback protocol	9.1	9.1	9.2
Firewall filters	8.4 (Limited filter terms)	9.1 (Limited filter terms)	9.2 (Limited filter terms)
Flexible Ethernet encapsulation	8.4	9.1	9.2
Graceful Routing Engine Switchover (GRES)	8.4	9.1	9.2

Table 3: Protocols and Applications Supported by the Enhanced Ethernet Services DPCs (DPCE-X) *(continued)*

Protocol or Application	First Junos OS Release Supported by DPC Model Number (DPC Name)		
	DPCE-X-4XGE-XFP DPCE-X-40GE-SFP (Enhanced Ethernet Services DPC)	DPCE-X-40GE-TX (Tri-Rate Enhanced Ethernet Services DPC)	DPCE-X-20GE-2XGE (Multi-Rate Enhanced Ethernet Services DPC)
In-service software upgrade (ISSU) (excludes IEEE 802.1ag OAM, IEEE 802.3ah, and LACP protocols)	9.1	9.1	9.2
Ingress hierarchical quality of service (HQoS) shaping and scheduling: • Group of virtual LANs (VLANs) level • Virtual LAN (VLAN) level • Port level	–	–	–
Intermediate System-to-Intermediate System (IS-IS)	8.4	9.1	9.2
IPv4 (No BGP)	8.4	9.1	9.2)
IP multicast (No BGP)	8.4	9.1	9.2
IPv6 (No BGP)	8.4	9.1	9.2)
IPv6 multicast (No BGP)	8.4	9.1	9.2)
IPv6 Neighbor Discovery (No BGP)	8.4	9.1)	9.2)
Layer 2 frame filtering	8.4	9.1	9.2
IEEE 802.3ad link aggregation	8.4	9.1	9.2
Link Aggregation Control Protocol (LACP)	8.4	9.1	9.2
Local loopback	8.4	9.1	9.2
MAC learning, policing, accounting, and filtering	8.4	9.1	9.2
Mobile IP	9.3	9.3	9.3
IEEE 802.1s Multiple Spanning Tree Protocol (MSTP) (part of IEEE 802.1Q VLANs)	8.4	9.1	9.2

Table 3: Protocols and Applications Supported by the Enhanced Ethernet Services DPCs (DPCE-X) *(continued)*

Protocol or Application	First Junos OS Release Supported by DPC Model Number (DPC Name)		
	DPCE-X-4XGE-XFP DPCE-X-40GE-SFP (Enhanced Ethernet Services DPC)	DPCE-X-40GE-TX (Tri-Rate Enhanced Ethernet Services DPC)	DPCE-X-20GE-2XGE (Multi-Rate Enhanced Ethernet Services DPC)
Multiple tag protocol identifiers (TPIDs)	8.4	9.1	9.2
Multiprotocol Label Switching (MPLS)	8.4	9.1	9.2
IEEE 802.3ah OAM • Discovery and link monitoring • Fault signaling and detection • Remote loopback	8.4	9.1	9.2
Multitopology Routing (MTR)	9.0	9.1	9.2
Open Shortest Path First (OSPF)	8.4	9.1	9.2
Packet mirroring	8.4	9.1	9.2
Quality of service (QoS) per port: • 8 queues per port • Shaping at queue level • Scheduling of queues based on weighted round-robin (WRR) per priority class • Random early detection (RED) • Weighted random early detection (WRED)	8.4	9.1	9.2
Quality of service (QoS) per virtual LAN (VLAN): • Accounting, filtering, and policing • IEEE 802.1p rewrite • Classification • Tricolor marking	8.4	9.1	9.2
Quality of service (QoS) queuing per virtual LAN (VLAN)	–	–	–
IEEE 802.1w Rapid Spanning Tree Protocol (RSTP)	8.4	9.1	9.2
Per-VLAN Spanning Tree (PVST)+	9.0	9.1	9.2

Table 3: Protocols and Applications Supported by the Enhanced Ethernet Services DPCs (DPCE-X) *(continued)*

Protocol or Application	First Junos OS Release Supported by DPC Model Number (DPC Name)		
	DPCE-X-4XGE-XFP DPCE-X-40GE-SFP (Enhanced Ethernet Services DPC)	DPCE-X-40GE-TX (Tri-Rate Enhanced Ethernet Services DPC)	DPCE-X-20GE-2XGE (Multi-Rate Enhanced Ethernet Services DPC)
RSVP	8.4	9.1	9.2
Routing Information Protocol (RIP)	8.4	9.1	9.2
SNMP	8.4	9.1	9.2
IEEE 802.1D Spanning Tree Protocol (STP)	8.4	9.1	9.2
Subscriber Management:	9.4	9.4	9.4
• Access Node Control Protocol (ANCP)	9.4	9.4	9.4
• Dynamic profiles	9.2	9.2	9.2
• Dynamic VLANs	9.5	9.5	9.5
• Enhanced Dynamic Host Configuration Protocol (DHCP) local server	9.3	9.3	9.3
• Enhanced DCHP relay	9.3	9.3	9.3
• Firewall filters	9.2	9.2	9.2
• Internet Group Management Protocol (IGMP)	9.2	9.2	9.2
• Mobile IP	9.3	9.3	9.3
• QoS	9.2	9.2	9.2
• Subscriber Secure Policy	9.4	9.4	9.4
Two-Way Active Measurement Protocol (TWAMP)	9.5	9.5	9.5

Table 3: Protocols and Applications Supported by the Enhanced Ethernet Services DPCs (DPCE-X) *(continued)*

Protocol or Application	First Junos OS Release Supported by DPC Model Number (DPC Name)		
	DPCE-X-4XGE-XFP DPCE-X-40GE-SFP (Enhanced Ethernet Services DPC)	DPCE-X-40GE-TX (Tri-Rate Enhanced Ethernet Services DPC)	DPCE-X-20GE-2XGE (Multi-Rate Enhanced Ethernet Services DPC)
IEEE 802.1Q VLANs: • VLAN stacking and rewriting • Channels defined by two stacked VLAN tags • Flexible VLAN tagging • IP service for nonstandard TPID and stacked VLAN tags	8.4	9.1	9.2
Virtual private LAN service (VPLS)	8.4	9.1	9.2
Virtual private network (VPN) (L2 VPN only)	8.4	9.1	9.2
Virtual Router Redundancy Protocol (VRRP) for IPv4	8.4	9.1	9.2

Related Documentation

- DPCs Supported on MX240, MX480, and MX960 Routers on page 6
- Protocols and Applications Supported by DPCs and Enhanced DPCs (DPC and DPCE-R) on page 49
- Protocols and Applications Supported by Enhanced Queuing IP Services DPCs (DPCE-R-Q) on page 61
- Protocols and Applications Supported by Enhanced Queuing Ethernet Services DPCs (DPCE-X-Q) on page 66
- Protocols and Applications Supported by the Multiservices DPC (MS-DPC) on page 71

Protocols and Applications Supported by Enhanced Queuing IP Services DPCs (DPCE-R-Q)

Table 4 on page 61 contains the first Junos OS Release support for protocols and applications on the MX240, MX480, and MX960 Enhanced Queuing IP Services DPCs. A dash indicates that the protocol or application is not supported.

Table 4: Protocols and Applications Supported by the Enhanced Queuing IP Services DPCs (DPCE-R-Q)

Protocol or Application	First Junos OS Release Supported by DPC Model Number (DPC Name)		
	DPCE-R-Q-4XGE-XFP DPCE-R-Q-40GE-SFP Enhanced Queuing IP Services DPC	DPCE-R-Q-20GE-SFP Enhanced Queuing IP Services DPC	DPCE-R-Q-20GE-2XGE Enhanced Queuing IP Services Multi-Rate DPC
Access Node Control Protocol (ANCP)	9.4	9.4	9.4
Accepts traffic destined for GRE tunnels or DVMRP (IP-in-IP) tunnels	8.5	9.1	9.3
Bidirectional Forwarding Detection protocol (BFD)	8.5	9.1	9.3
Border Gateway Protocol (BGP)	8.5	9.1	9.3
BGP/Multiprotocol Label Switching (MPLS) virtual private networks (VPNs)	8.5	9.1	9.3
Distance Vector Multicast Routing Protocol (DVMRP) and generic routing encapsulation (GRE) support—access side and server side	8.5	9.1	9.3
IEEE 802.1ag Ethernet OAM Continuity Check protocol	8.5	9.1	9.3
IEEE 802.1ag Ethernet OAM Linktrace protocol	9.0	9.1	9.3
IEEE 802.1ag Ethernet OAM Loopback protocol	9.1	9.1	9.3
Firewall filters	8.5	9.1	9.3
Flexible Ethernet encapsulation	8.5	9.1	9.3
Graceful Routing Engine Switchover (GRES)	8.5	9.1	9.3
In-service software upgrade (ISSU) (excludes IEEE 802.1ag OAM, IEEE 802.3ah, and LACP protocols)	9.3	9.3	9.3

Table 4: Protocols and Applications Supported by the Enhanced Queuing IP Services DPCs (DPCE-R-Q) *(continued)*

Protocol or Application	First Junos OS Release Supported by DPC Model Number (DPC Name)		
	DPCE-R-Q-4XGE-XFP DPCE-R-Q-40GE-SFP Enhanced Queuing IP Services DPC	DPCE-R-Q-20GE-SFP Enhanced Queuing IP Services DPC	DPCE-R-Q-20GE-2XGE Enhanced Queuing IP Services Multi-Rate DPC
Ingress hierarchical quality of service (HQoS) shaping and scheduling: • Group of virtual LANs (VLANs) level • Virtual LAN (VLAN) level • Port level	9.0	9.1	9.3
Intermediate System-to-Intermediate System (IS-IS)	8.5	9.1	9.3
IPv4	8.5	9.1	9.3
IP multicast	8.5	9.1	9.3
IPv6	8.5	9.1	9.3
IPv6 multicast	8.5	9.1	9.3
IPv6 Neighbor Discovery	8.5	9.1	9.3
Layer 2 frame filtering	8.5	9.1	9.3
IEEE 802.3ad link aggregation	8.5	9.1	9.3
Link Aggregation Control Protocol (LACP)	8.5	9.1	9.3
Local loopback	8.5	9.1	9.3
MAC learning, policing, accounting, and filtering	8.5	9.1	9.3
Mobile IP	9.3	9.3	9.3
IEEE 802.1s Multiple Spanning Tree Protocol (MSTP) (part of IEEE 802.1Q VLANs)	8.5	9.1	9.3
Multiple tag protocol identifiers (TPIDs)	8.5	9.1	9.3
Multiprotocol Label Switching (MPLS)	8.5	9.1	9.3

Table 4: Protocols and Applications Supported by the Enhanced Queuing IP Services DPCs (DPCE-R-Q) *(continued)*

Protocol or Application	First Junos OS Release Supported by DPC Model Number (DPC Name)		
	DPCE-R-Q-4XGE-XFP DPCE-R-Q-40GE-SFP Enhanced Queuing IP Services DPC	DPCE-R-Q-20GE-SFP Enhanced Queuing IP Services DPC	DPCE-R-Q-20GE-2XGE Enhanced Queuing IP Services Multi-Rate DPC
IEEE 802.3ah OAM • Discovery and link monitoring • Fault signaling and detection • Remote loopback	8.5	9.1	9.3
Multitopology Routing (MTR)	9.0	9.1	9.3
Open Shortest Path First (OSPF)	8.5	9.1	9.3
Packet mirroring	8.5	9.1	9.3
Quality of service (QoS) per port: • 8 queues per port • Shaping at port level • Scheduling of queues based on weighted round-robin (WRR) per priority class • Random early detection (RED) • Weighted random early detection (WRED)	8.5	9.1	9.3
Quality of service (QoS) per virtual LAN (VLAN): • Accounting, filtering, and policing • IEEE 802.1p rewrite • Classification • Tricolor marking • Shaping at queue and port level • Scheduling of queues based on weighted round-robin (WRR) per priority class • Random early detection (RED) • Weighted random early detection (WRED)	8.5	9.1	9.3
Quality of service (QoS) queuing per virtual LAN (VLAN)	8.5	9.1	9.3
IEEE 802.1w Rapid Spanning Tree Protocol (RSTP)	8.5	9.1	9.3
Per-VLAN Spanning Tree (PVST)+	9.0	9.1	9.3

Table 4: Protocols and Applications Supported by the Enhanced Queuing IP Services DPCs (DPCE-R-Q) *(continued)*

Protocol or Application	First Junos OS Release Supported by DPC Model Number (DPC Name)		
	DPCE-R-Q-4XGE-XFP DPCE-R-Q-40GE-SFP Enhanced Queuing IP Services DPC	DPCE-R-Q-20GE-SFP Enhanced Queuing IP Services DPC	DPCE-R-Q-20GE-2XGE Enhanced Queuing IP Services Multi-Rate DPC
RSVP	8.5	9.1	9.3
Routing Information Protocol (RIP)	8.5	9.1	9.3
SNMP	8.5	9.1	9.3
IEEE 802.1D Spanning Tree Protocol (STP)	8.5	9.1	9.3
Subscriber Management:	9.4	9.4	9.4
• Access Node Control Protocol (ANCP)	9.4	9.4	9.4
• Dynamic profiles	9.2	9.2	9.2
• Dynamic VLANs	9.5	9.5	9.5
• Enhanced Dynamic Host Configuration Protocol (DHCP) local server	9.3	9.3	9.3
• Enhanced DCHP relay	9.3	9.3	9.3
• Firewall filters	9.2	9.2	9.2
• Internet Group Management Protocol (IGMP)	9.2	9.2	9.2
• Mobile IP	9.3	9.3	9.3
• QoS	9.2	9.2	9.2
• Subscriber Secure Policy	9.4	9.4	9.4
Two-Way Active Measurement Protocol (TWAMP)	9.5	9.5	9.5

Table 4: Protocols and Applications Supported by the Enhanced Queuing IP Services DPCs (DPCE-R-Q) *(continued)*

Protocol or Application	First Junos OS Release Supported by DPC Model Number (DPC Name)		
	DPCE-R-Q-4XGE-XFP DPCE-R-Q-40GE-SFP Enhanced Queuing IP Services DPC	DPCE-R-Q-20GE-SFP Enhanced Queuing IP Services DPC	DPCE-R-Q-20GE-2XGE Enhanced Queuing IP Services Multi-Rate DPC
IEEE 802.1Q VLANs: • VLAN stacking and rewriting • Channels defined by two stacked VLAN tags • Flexible VLAN tagging • IP service for nonstandard TPID and stacked VLAN tags	8.5	9.1	9.3
Virtual private LAN service (VPLS)	8.5	9.1	9.3
Virtual private network (VPN)	8.5	9.1	9.3
Virtual Router Redundancy Protocol (VRRP) for IPv4	8.5	9.1	9.3

Related Documentation

- DPCs Supported on MX240, MX480, and MX960 Routers on page 6
- Protocols and Applications Supported by DPCs and Enhanced DPCs (DPC and DPCE-R) on page 49
- Protocols and Applications Supported by Enhanced Ethernet Services DPCs (DPCE-X) on page 56
- Protocols and Applications Supported by Enhanced Queuing Ethernet Services DPCs (DPCE-X-Q) on page 66
- Protocols and Applications Supported by the Multiservices DPC (MS-DPC) on page 71

Protocols and Applications Supported by Enhanced Queuing Ethernet Services DPCs (DPCE-X-Q)

Table 5 on page 66 contains the first Junos OS Release support for protocols and applications on the MX240, MX480, and MX960 Enhanced Queuing Ethernet Services DPCs. A dash indicates that the protocol or application is not supported.

Table 5: Protocols and Applications Supported by the Enhanced Queuing Ethernet Services DPCs (DPCE-X-Q)

Protocol or Application	DPCE-X-Q-4XGE-XFP DPCE-X-Q-40GE-SFP (Enhanced Queuing Ethernet Services DPC)
Access Node Control Protocol (ANCP)	9.4
Accepts traffic destined for GRE tunnels or DVMRP (IP-in-IP) tunnels	8.5
Bidirectional Forwarding Detection protocol (BFD)	8.5
Border Gateway Protocol (BGP)	8.5
BGP/Multiprotocol Label Switching (MPLS) virtual private networks (VPNs)	8.5
Distance Vector Multicast Routing Protocol (DVMRP) and generic routing encapsulation (GRE) support—access side and server side	8.5
IEEE 802.1ag Ethernet OAM Continuity Check protocol	8.5
IEEE 802.1ag Ethernet OAM Linktrace protocol	9.0
IEEE 802.1ag Ethernet OAM Loopback protocol	9.1
Firewall filters	8.5 (Limited filter terms)
Flexible Ethernet encapsulation	8.5
Graceful Routing Engine Switchover (GRES)	8.5
In-service software upgrade (ISSU) (excludes IEEE 802.1ag OAM, IEEE 802.3ah, and LACP protocols)	9.3

Table 5: Protocols and Applications Supported by the Enhanced Queuing Ethernet Services DPCs (DPCE-X-Q) *(continued)*

Protocol or Application	DPCE-X-Q-4XGE-XFP DPCE-X-Q-40GE-SFP (Enhanced Queuing Ethernet Services DPC)
Ingress hierarchical quality of service (HQoS) shaping and scheduling: • Group of virtual LANs (VLANs) level • Virtual LAN (VLAN) level • Port level	9.0
Intermediate System-to-Intermediate System (IS-IS)	8.5
IPv4 (No BGP)	8.5
IP multicast (No BGP)	8.5
IPv6 (No BGP)	8.5
IPv6 multicast (No BGP)	8.5
IPv6 Neighbor Discovery (No BGP)	8.5
Layer 2 frame filtering	8.5
IEEE 802.3ad link aggregation	8.5
Link Aggregation Control Protocol (LACP)	8.5
Local loopback	8.5
MAC learning, policing, accounting, and filtering	8.5
Mobile IP	9.3
IEEE 802.1s Multiple Spanning Tree Protocol (MSTP) (part of IEEE 802.1Q VLANs)	8.5
Multiple tag protocol identifiers (TPIDs)	8.5
Multiprotocol Label Switching (MPLS)	8.5
IEEE 802.3ah OAM • Discovery and link monitoring • Fault signaling and detection • Remote loopback	8.5

Table 5: Protocols and Applications Supported by the Enhanced Queuing Ethernet Services DPCs (DPCE-X-Q) *(continued)*

Protocol or Application	DPCE-X-Q-4XGE-XFP DPCE-X-Q-40GE-SFP (Enhanced Queuing Ethernet Services DPC)
Multitopology Routing (MTR)	9.0
Open Shortest Path First (OSPF)	8.5
Packet mirroring	8.5
Quality of service (QoS) per port: • 8 queues per port • Shaping at port level • Scheduling of queues based on weighted round-robin (WRR) per priority class • Random early detection (RED) • Weighted random early detection (WRED)	8.5
Shaping at queue level	–
Quality of service (QoS) per virtual LAN (VLAN): • Accounting, filtering, and policing • IEEE 802.1p rewrite • Classification • Tricolor marking • Shaping at port level • Scheduling of queues based on weighted round-robin (WRR) per priority class • Random early detection (RED) • Weighted random early detection (WRED)	8.5
Shaping at queue level	–
Quality of service (QoS) queuing per virtual LAN (VLAN)	8.5
IEEE 802.1w Rapid Spanning Tree Protocol (RSTP)	8.5
Per-VLAN Spanning Tree (PVST)+	9.0
Remote loopback	8.5
RSVP	8.5
Routing Information Protocol (RIP)	8.5

Table 5: Protocols and Applications Supported by the Enhanced Queuing Ethernet Services DPCs (DPCE-X-Q) *(continued)*

Protocol or Application	DPCE-X-Q-4XGE-XFP DPCE-X-Q-40GE-SFP (Enhanced Queuing Ethernet Services DPC)
SNMP	8.5
IEEE 802.1D Spanning Tree Protocol (STP)	8.5
Subscriber Management:	9.4
• Access Node Control Protocol (ANCP)	9.4
• Dynamic profiles	9.2
• Dynamic VLANs	9.5
• Enhanced Dynamic Host Configuration Protocol (DHCP) local server	9.3
• Enhanced DCHP relay	9.3
• Firewall filters	9.2
• Internet Group Management Protocol (IGMP)	9.2
• Mobile IP	9.3
• QoS	9.2
• Subscriber Secure Policy	9.4
Two-Way Active Measurement Protocol (TWAMP)	9.5
IEEE 802.1Q VLANs: • VLAN stacking and rewriting • Channels defined by two stacked VLAN tags • Flexible VLAN tagging • IP service for nonstandard TPID and stacked VLAN tags	8.5
Virtual private LAN service (VPLS)	8.5
Virtual private network (VPN)	8.5 (L2 VPN only)
Virtual Router Redundancy Protocol (VRRP) for IPv4	8.5

Related Documentation

- DPCs Supported on MX240, MX480, and MX960 Routers on page 6
- Protocols and Applications Supported by DPCs and Enhanced DPCs (DPC and DPCE-R) on page 49
- Protocols and Applications Supported by Enhanced Ethernet Services DPCs (DPCE-X) on page 56
- Protocols and Applications Supported by Enhanced Queuing IP Services DPCs (DPCE-R-Q) on page 61
- Protocols and Applications Supported by the Multiservices DPC (MS-DPC) on page 71

Protocols and Applications Supported by the Multiservices DPC (MS-DPC)

Table 6 on page 71 contains the first Junos OS Release support for protocols and applications on the MX240, MX480, and MX960 Multiservices DPCs. A dash indicates that the protocol or application is not supported.

Table 6: Protocols and Applications Supported by the Multiservices DPC (MS-DPC)

Protocol or Application	MS-DPC
Accepts traffic destined for GRE tunnels	9.3
Active flow monitoring exports cflowd version 5 and version 8 records	9.3
Active flow monitoring exports flow monitoring version 9 records, based on RFC 3954	9.3
Graceful Routing Engine Switchover (GRES)	9.4
GRE dont fragment	9.3
GRE Key	9.3
GRE reassembly	9.3
IP Security (IPSec) encryption	9.3
Network Address Translation (NAT) for IP addresses	9.3
Packet-triggered dynamic subscribers and policy control (PTSP)	10.2
Port Address Translation (PAT) for port numbers	9.3
Real-time Performance Monitoring (RPM)	9.3
Stateful firewall with packet inspection: detects SYN attacks, ICMP and UDP floods, and ping-of-death attacks	9.3
Tunnel services:	
• GRE unicast tunneling-Supports GRE fragmentation	9.3
• IP-IP unicast tunneling	9.4
• Multicast tunneling	9.4
• Protocol Independent Multicast (PIM) sparse mode unicast tunneling	9.4

Table 6: Protocols and Applications Supported by the Multiservices DPC (MS-DPC) *(continued)*

Protocol or Application	MS-DPC
• Virtual loopback tunneling (VT)	9.4
Voice over IP (VoIP) services: • Border Gateway Function (BGF) using external H.248/Ia control • Integrated Multi-Service Gateway (IMSG)—Session Border Controller	10.2

Related Documentation

- DPCs Supported on MX240, MX480, and MX960 Routers on page 6
- Protocols and Applications Supported by DPCs and Enhanced DPCs (DPC and DPCE-R) on page 49
- Protocols and Applications Supported by Enhanced Ethernet Services DPCs (DPCE-X) on page 56
- Protocols and Applications Supported by Enhanced Queuing IP Services DPCs (DPCE-R-Q) on page 61
- Protocols and Applications Supported by Enhanced Queuing Ethernet Services DPCs (DPCE-X-Q) on page 66

MX Series MPCs

MX Series MPC Overview

Modular Port Concentrators (MPCs) provide packet forwarding services. The MPCs are inserted into a slot in an MX240, MX480, or MX960 router. Modular Interface Cards (MICs) provide the physical interfaces and install into the MPCs. You can install up to two MICs of different media types in the same MPC as long as the MPC supports those MICs.

A specialized fixed configuration MPC provides higher port density over MICs and combines packet forwarding and Ethernet interfaces onto a single line card. The fixed configuration MPC is inserted into a slot in a router and contains no slots for MICs.

MICs receive incoming packets from the network and transmit outgoing packets to the network. During this process, each MIC performs framing and high-speed signaling for its media type. Before transmitting outgoing data packets through the MIC interfaces, the MPCs encapsulate the packets received. Each MPC is equipped with up to four Junos Trio chipsets, which perform control functions tailored to the MPC's media type.

You must install a high-capacity fan tray to use an MPC. The maximum number of supported MPCs varies per router and hardware configuration:

- MX960 router—Up to 12 MPCs (For power requirements, see Calculating Power Requirements for MX960 Routers.
- MX480 router—Up to 6 MPCs (For power requirements, seeCalculating Power Requirements for MX480 Routers.

- MX240 router—Up to 3 MPCs (For power requirements, see Calculating Power Requirements for MX240 Routers.

When a slot is not occupied by an MPC, you must insert a blank DPC to fill the empty slot and ensure proper cooling of the system. For complete information about installing and handling MPCs, see the hardware guide for your router.

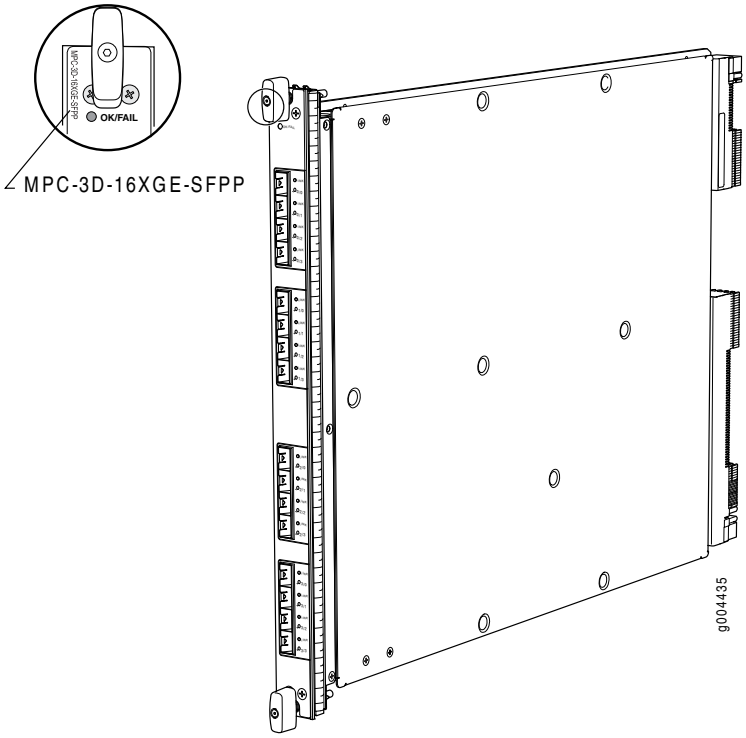
MPCs Supported by MX240, MX480, and MX960 Routers

Table 7 on page 74 lists the MPCs supported by MX240, MX480, and MX960 routers.

Table 7: MPCs Supported by MX240, MX480, and MX960 Routers

MPC Name	MPC Model Number	Ports	First Junos OS Release
Fixed Configuration MPCs			
"16x10GE MPC" on page 75	MPC-3D-16XGE-SFPP	16	10.0R2
MPCs			
"MPC1" on page 77	MX-MPC1-3D	–	10.2
"MPC1E" on page 78	MX-MPC1E-3D	–	11.2R4
"MPC1 Q" on page 79	MX-MPC1-3D-Q	–	10.2
"MPC1E Q" on page 80	MX-MPC1E-3D-Q	–	11.2R4
"MPC2" on page 81	MX-MPC2-3D	–	10.1
"MPC2E" on page 82	MX-MPC2E-3D	–	11.2R4
"MPC2 Q" on page 83	MX-MPC2-3D-Q	–	10.1
"MPC2E Q" on page 84	MX-MPC2E-3D-Q	–	11.2R4
"MPC2 EQ" on page 85	MX-MPC2-3D-EQ	–	10.1
"MPC2E EQ" on page 86	MX-MPC2E-3D-EQ	–	11.2R4
"MPC3E" on page 87	MX-MPC3E-3	–	12.1

16x10GE MPC



Software release	• Junos OS Release 10.0R2 and later

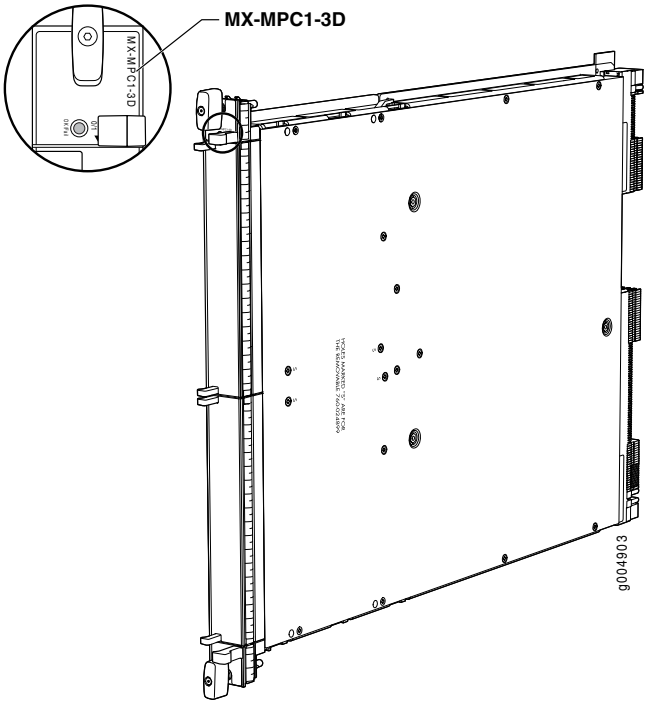
Description	• Fixed configuration MPC with sixteen 10-Gigabit Ethernet ports
	• Power requirement: 9.17 A @ 48 V (440 W)
	• Weight: 18.35 lb (8.3 kg)
	• Model numbers:
	  ◦ MPC-3D-16XGE-SFPP
	  ◦ MPC-3D-16XGE-SFPP-R-B

Hardware features	• High-performance throughput on each port at speeds up to 10 Gbps • Four fully programmable Junos Trio chipsets for increased scaling for bandwidth, subscribers, and services • One Junos Trio chipset per set of four ports • LAN-PHY mode at 10.3125 Gbps
Software features	• Optical diagnostics and related alarms • See "Protocols and Applications Supported by MX240, MX480, MX960 MPCs" on page 88 for information about the protocols and applications that this MPC supports.

Cables and connectors	• 10-Gigabit SFP+ transceivers:
	  • Connector: Duplex LC/PC (Rx and Tx)
	  • 10GBASE-ER (model number: SFPP-10GE-ER)
	  • 10GBASE-LR (model number: SFPP-10GE-LR)
	  • 10GBASE-LRM (model number: SFPP-10GE-LRM)
	  • 10GBASE-SR (model number: SFPP-10GE-SR)
	Optical interface specifications—see 10-Gigabit Ethernet 10GBASE Optical Interface Specifications

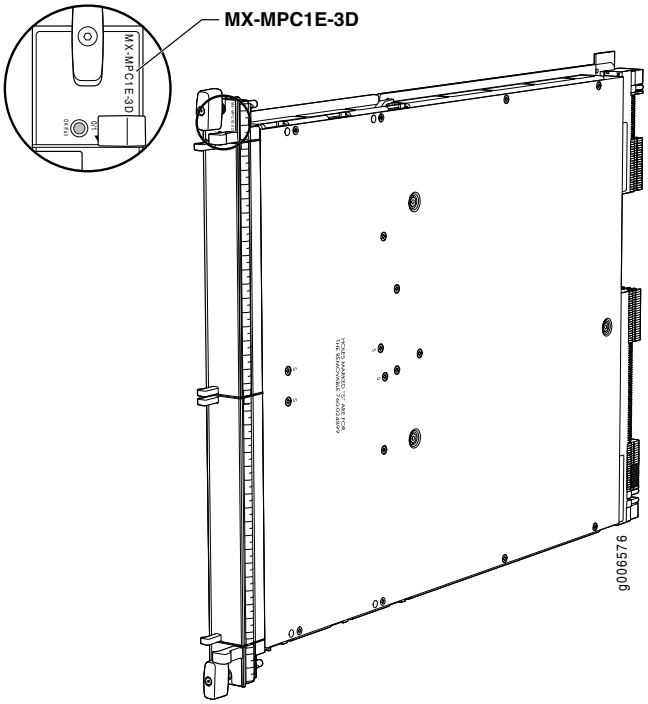
LEDs	**OK/FAIL** LED, one bicolor: • Steady green—MPC is functioning normally. • Blinking green—MPC is transitioning online or offline. • Red—MPC has failed. Enable/disable LED, one bicolor per port: • Green—Port is enabled. • Yellow—Port is not functioning normally. • Off—Port is disabled. The enable/disable LEDs are labeled in groups of four: • **0/0** through **0/3** • **1/0** through **1/3** • **2/0** through **2/3** • **3/0** through **3/3**

MPC1



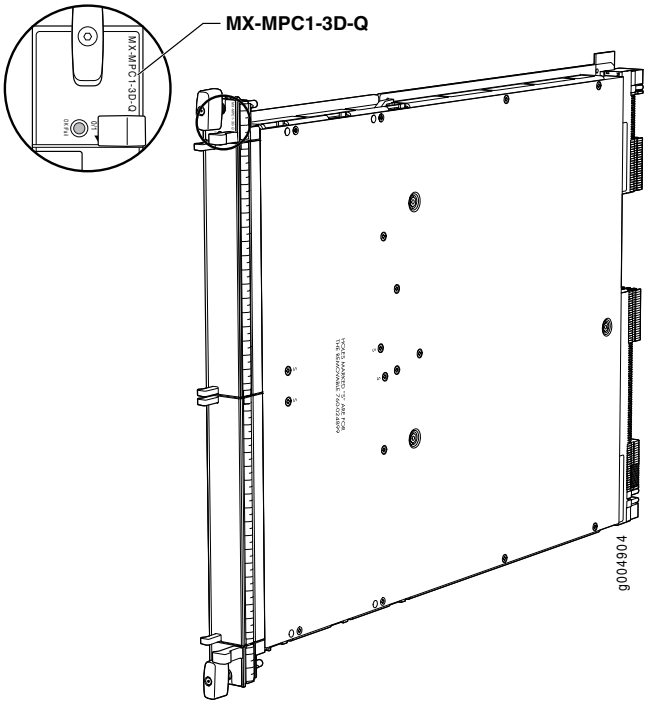
Software release	• Junos OS Release 10.2 and later
Description	• Power requirement: 3.4 A @ 48 V (165 W) • Weight: 13.8 lb (6.3 kg) • Model number: MX-MPC1-3D
Hardware features	• Two slots for MICs labeled **PIC 0/1** and **PIC 2/3** • One Junos Trio chipset for increased scaling for bandwidth, subscribers, and services • LAN-PHY mode at 10.3125 Gbps • WAN-PHY mode at 9.953 Gbps
Software features	• See "Protocols and Applications Supported by MX240, MX480, MX960 MPCs" on page 88 for information about the protocols and applications that this MPC supports.
LEDs	**OK/FAIL** LED, one bicolor: • Steady green—MPC is functioning normally. • Blinking green—MPC is transitioning online or offline. • Red—MPC has failed.

MPC1E



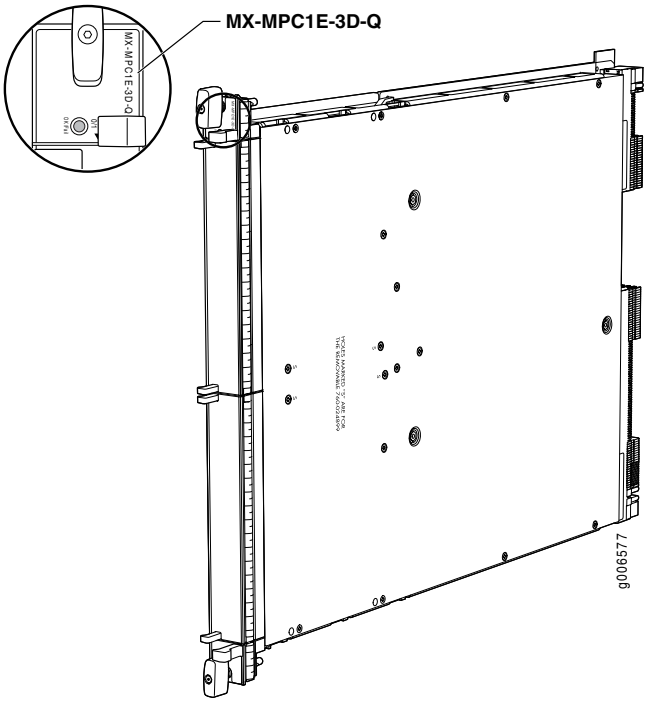
Software release	• Junos OS Release 11.2R4 and later
Description	• Power requirement: 3.4 A @ 48 V (165 W) • Weight: 13.8 lb (6.3 kg) • Model number: MX-MPC1E-3D
Hardware features	• Two slots for MICs labeled **PIC 0/1** and **PIC 2/3** • One Junos Trio chipset for increased scaling for bandwidth, subscribers, and services • LAN-PHY mode at 10.3125 Gbps • WAN-PHY mode at 9.953 Gbps
Software features	• See "Protocols and Applications Supported by MX240, MX480, MX960 Enhanced MPCs (MPCE)" on page 96 for information about the protocols and applications that this MPC supports.
LEDs	**OK/FAIL** LED, one bicolor: • Steady green—MPC is functioning normally. • Blinking green—MPC is transitioning online or offline. • Red—MPC has failed.

MPC1 Q



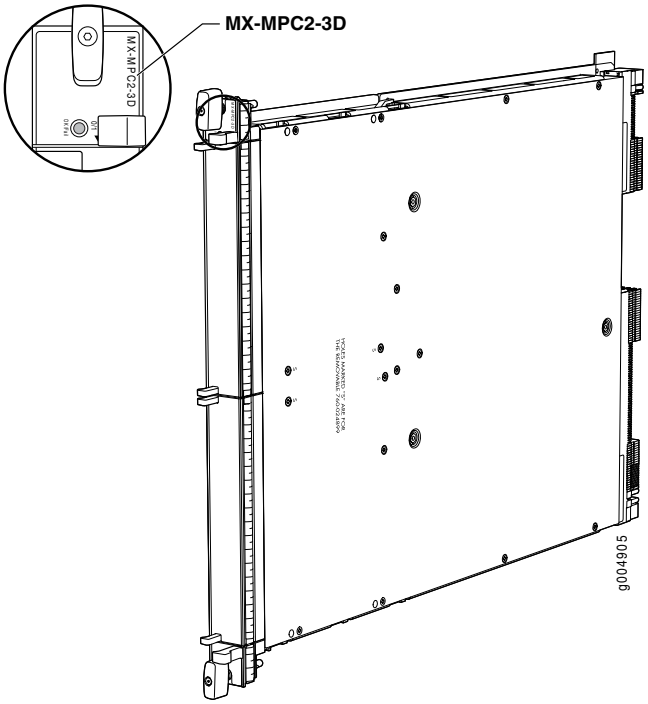
Software release	• Junos OS Release 10.2 and later
Description	• Power requirement: 3.65 A @ 48 V (175 W) • Weight: 13.8 lb (6.3 kg) • Model number: MX-MPC1-3D-Q
Hardware features	• Two slots for MICs labeled **PIC 0/1** and **PIC 2/3** • One Junos Trio chipset for increased scaling for bandwidth, subscribers, and services • LAN-PHY mode at 10.3125 Gbps • WAN-PHY mode at 9.953 Gbps
Software features	• See "Protocols and Applications Supported by MX240, MX480, MX960 MPCs" on page 88 for information about the protocols and applications that this MPC supports.
LEDs	**OK/FAIL** LED, one bicolor: • Steady green—MPC is functioning normally. • Blinking green—MPC is transitioning online or offline. • Red—MPC has failed.

MPC1E Q



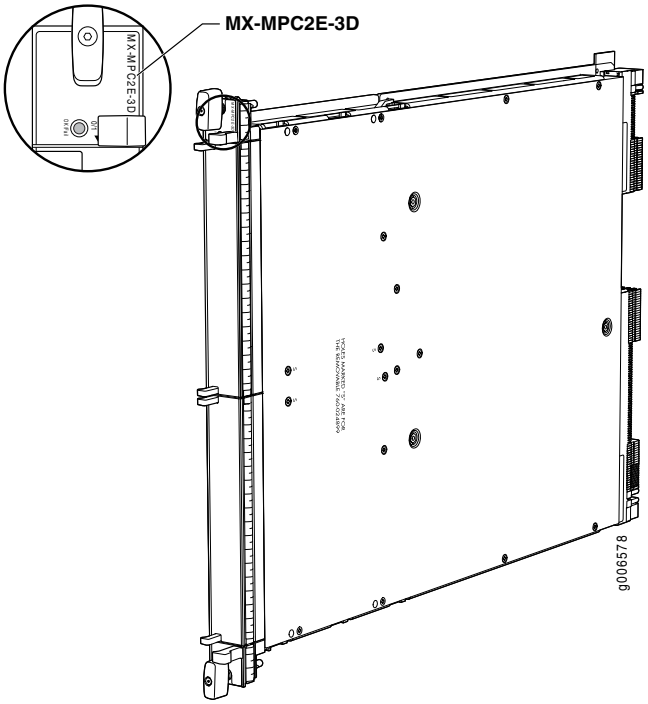
Software release	• Junos OS Release 11.2R4 and later
Description	• Power requirement: 3.65 A @ 48 V (175 W) • Weight: 13.8 lb (6.3 kg) • Model number: MX-MPC1E-3D-Q
Hardware features	• Two slots for MICs labeled **PIC 0/1** and **PIC 2/3** • One Junos Trio chipset for increased scaling for bandwidth, subscribers, and services • LAN-PHY mode at 10.3125 Gbps • WAN-PHY mode at 9.953 Gbps
Software features	• See "Protocols and Applications Supported by MX240, MX480, MX960 Enhanced MPCs (MPCE)" on page 96 for information about the protocols and applications that this MPC supports.
LEDs	**OK/FAIL** LED, one bicolor: • Steady green—MPC is functioning normally. • Blinking green—MPC is transitioning online or offline. • Red—MPC has failed.

MPC2



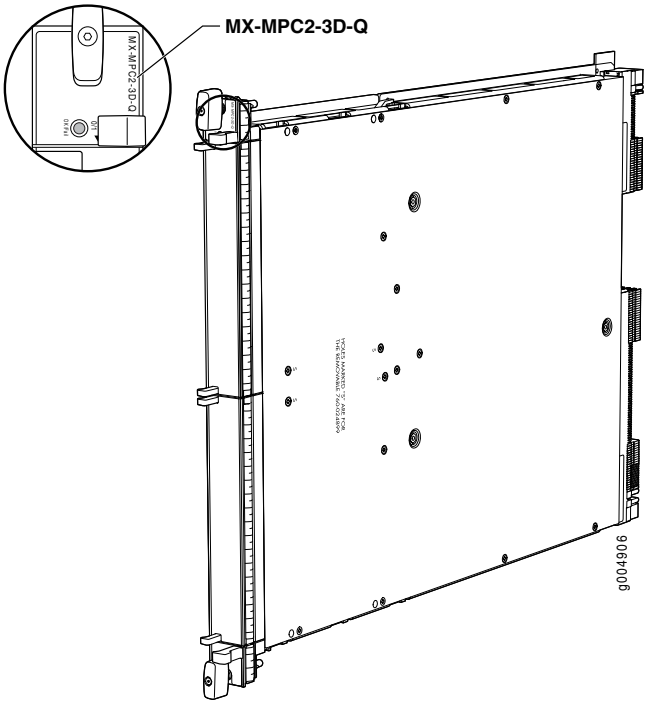
Software release	• Junos OS Release 10.1 and later
Description	• Power requirement: 5.7 A @ 48 V (274 W) • Weight: 14 lb (6.4 kg) • Model number: MX-MPC2-3D
Hardware features	• Two slots for MICs labeled **PIC 0/1** and **PIC 2/3** • Two Junos Trio chipsets for increased scaling for bandwidth, subscribers, and services • LAN-PHY mode at 10.3125 Gbps • WAN-PHY mode at 9.953 Gbps
Software features	• See "Protocols and Applications Supported by MX240, MX480, MX960 MPCs" on page 88 for information about the protocols and applications that this MPC supports.
LEDs	**OK/FAIL** LED, one bicolor: • Steady green—MPC is functioning normally. • Blinking green—MPC is transitioning online or offline. • Red—MPC has failed.

MPC2E



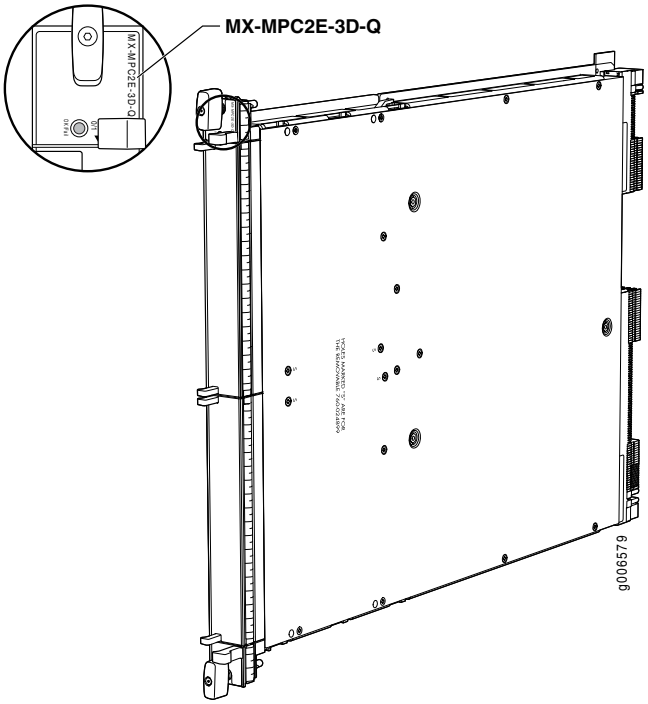
Software release	• Junos OS Release 11.2R4 and later
Description	• Power requirement: 5.7 A @ 48 V (274 W) • Weight: 14 lb (6.4 kg) • Model number: MX-MPC2E-3D
Hardware features	• Two slots for MICs labeled **PIC 0/1** and **PIC 2/3** • Two Junos Trio chipsets for increased scaling for bandwidth, subscribers, and services • LAN-PHY mode at 10.3125 Gbps • WAN-PHY mode at 9.953 Gbps
Software features	• See "Protocols and Applications Supported by MX240, MX480, MX960 Enhanced MPCs (MPCE)" on page 96 for information about the protocols and applications that this MPC supports.
LEDs	**OK/FAIL** LED, one bicolor: • Steady green—MPC is functioning normally. • Blinking green—MPC is transitioning online or offline. • Red—MPC has failed.

MPC2 Q



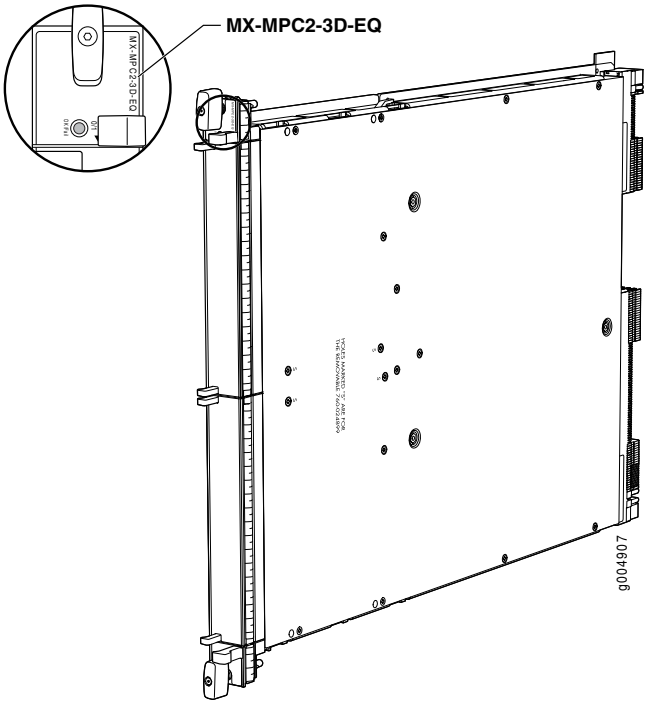
Software release	• Junos OS Release 10.1 and later
Description	• Power requirement: 6.13 A @ 48 V (294 W) • Weight: 14 lb (6.4 kg) • Model number: MX-MPC2-3D-Q
Hardware features	• Two slots for MICs labeled **PIC 0/1** and **PIC 2/3** • Two Junos Trio chipsets for increased scaling for bandwidth, subscribers, and services • LAN-PHY mode at 10.3125 Gbps • WAN-PHY mode at 9.953 Gbps
Software features	• See "Protocols and Applications Supported by MX240, MX480, MX960 MPCs" on page 88 for information about the protocols and applications that this MPC supports.
LEDs	**OK/FAIL** LED, one bicolor: • Steady green—MPC is functioning normally. • Blinking green—MPC is transitioning online or offline. • Red—MPC has failed.

MPC2E Q



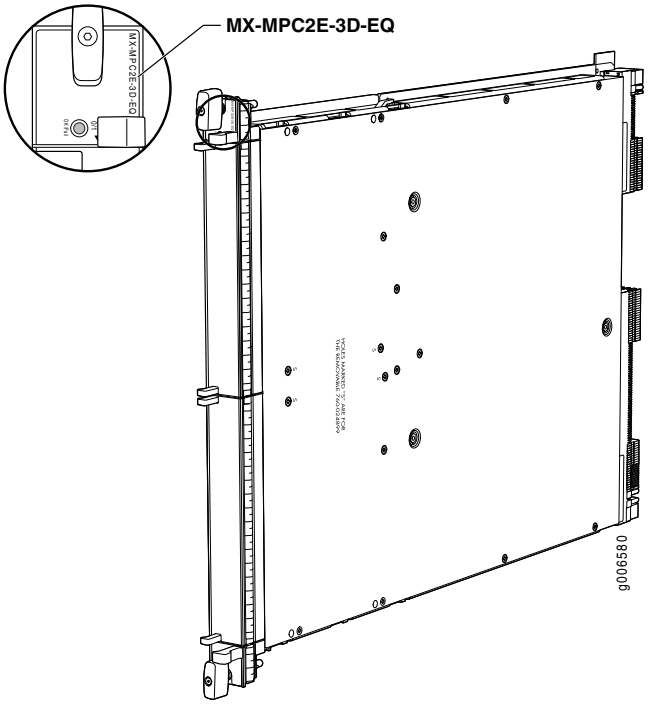
Software release	• Junos OS Release 11.2R4 and later
Description	• Power requirement: 6.13 A @ 48 V (294 W) • Weight: 14 lb (6.4 kg) • Model number: MX-MPC2E-3D-Q
Hardware features	• Two slots for MICs labeled **PIC 0/1** and **PIC 2/3** • Two Junos Trio chipsets for increased scaling for bandwidth, subscribers, and services • LAN-PHY mode at 10.3125 Gbps • WAN-PHY mode at 9.953 Gbps
Software features	• See "Protocols and Applications Supported by MX240, MX480, MX960 Enhanced MPCs (MPCE)" on page 96 for information about the protocols and applications that this MPC supports.
LEDs	**OK/FAIL** LED, one bicolor: • Steady green—MPC is functioning normally. • Blinking green—MPC is transitioning online or offline. • Red—MPC has failed.

MPC2 EQ



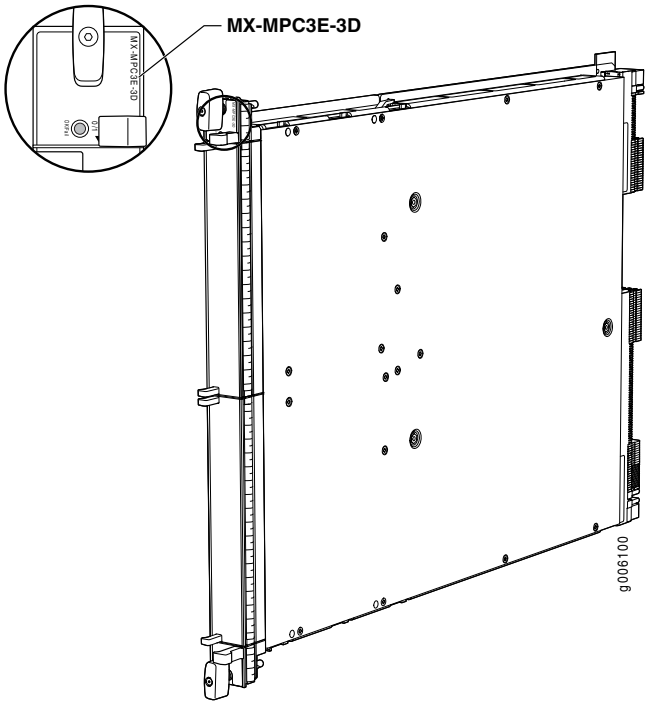
Software release	• Junos OS Release 10.1 and later
Description	• Power requirement: 6.13 A @ 48 V (294 W) • Weight: 14 lb (6.4 kg) • Model number: MX-MPC2-3D-EQ
Hardware features	• Two slots for MICs labeled **PIC 0/1** and **PIC 2/3** • Two Junos Trio chipsets for increased scaling for bandwidth, subscribers, and services • LAN-PHY mode at 10.3125 Gbps • WAN-PHY mode at 9.953 Gbps
Software features	• See "Protocols and Applications Supported by MX240, MX480, MX960 MPCs" on page 88 for information about the protocols and applications that this MPC supports.
LEDs	**OK/FAIL** LED, one bicolor: • Steady green—MPC is functioning normally. • Blinking green—MPC is transitioning online or offline. • Red—MPC has failed.

MPC2E EQ



Software release	• Junos OS Release 11.2R4 and later
Description	• Power requirement: 6.13 A @ 48 V (294 W) • Weight: 14 lb (6.4 kg) • Model number: MX-MPC2E-3D-EQ
Hardware features	• Two slots for MICs labeled **PIC 0/1** and **PIC 2/3** • Two Junos Trio chipsets for increased scaling for bandwidth, subscribers, and services • LAN-PHY mode at 10.3125 Gbps • WAN-PHY mode at 9.953 Gbps
Software features	• See "Protocols and Applications Supported by MX240, MX480, MX960 Enhanced MPCs (MPCE)" on page 96 for information about the protocols and applications that this MPC supports.
LEDs	**OK/FAIL** LED, one bicolor: • Steady green—MPC is functioning normally. • Blinking green—MPC is transitioning online or offline. • Red—MPC has failed.

MPC3E



Software release	• Junos OS Release 12.1 and later
Description	• Power requirement: 10.83 A @ 48 V (440 W; plus 40 W for each of the two MICs) • Requires high-capacity fan trays • Weight: 14.94 lb (6.78 kg) • Model number: MX-MPC3E-3D
Hardware features	• Two slots for MICs labeled **MIC 0/1** and **MIC 2/3** • Chipset for increased scaling for bandwidth, subscribers, and services
Software features	• See "Protocols and Applications Supported by MX240, MX480, MX960 MPCs" on page 88 for information about the protocols and applications that this MPC supports.
LEDs	**OK/FAIL** LED, one bicolor: • Steady green—MPC is functioning normally. • Blinking green—MPC is transitioning online or offline. • Red—MPC has failed.

MX240, MX480, and MX960 MPC Protocol and Application Support

Protocols and Applications Supported by MX240, MX480, MX960 MPCs

Table 8 on page 88 contains the first Junos OS Release support for protocols and applications on the MX240, MX480, MX960 MPCs (MPCs).

A dash indicates that the protocol or application is not supported.

Table 8: Protocols and Applications Supported by the MX240, MX480, MX960 MPCs

Protocol or Application	First Junos OS Release Supported by MPC Model Number (MPC Name)					
	MPC-3D-16XGE-SFPP (16x10GE MPC)	MX-MPC1-3D (MPC1)	MX-MPC2-3D (MPC2)	MX-MPC1-3D-Q (MPC1 Q)	MX-MPC2-3D-Q (MPC2 Q)	MX-MPC2-3D-EQ (MPC2 EQ)
Access Node Control Protocol (ANCP)	–	10.2	10.2	10.2	10.2	10.2
Accepts traffic destined for GRE tunnels or DVMRP (IP-in-IP) tunnels	10.0R2	10.2	10.1	10.2	10.1	10.1
Bidirectional Forwarding Detection protocol (BFD)	10.0R2	10.2	10.1	10.2	10.1	10.1
Border Gateway Protocol (BGP)	10.0R2	10.2	10.1	10.2	10.1	10.1
BGP/Multiprotocol Label Switching (MPLS) virtual private networks (VPNs)	10.0R2	10.2	10.1	10.2	10.1	10.1
Distance Vector Multicast Routing Protocol (DVMRP) and generic routing encapsulation (GRE) support—access side and server side	10.0R2	10.2	10.1	10.2	10.1	10.1
IEEE 802.1ag Ethernet OAM Continuity Check protocol	10.2 (bridge family supported in 10.4)	10.2 (bridge family supported in 10.4)	10.2 (bridge family supported in 10.4)	10.2 (bridge family supported in 10.4)	10.2 (bridge family supported in 10.4)	10.2 (bridge family supported in 10.4)

Table 8: Protocols and Applications Supported by the MX240, MX480, MX960 MPCs *(continued)*

Protocol or Application	First Junos OS Release Supported by MPC Model Number (MPC Name)					
	MPC-3D-16XGE-SFPP (16x10GE MPC)	MX-MPC1-3D (MPC1)	MX-MPC2-3D (MPC2)	MX-MPC1-3D-Q (MPC1 Q)	MX-MPC2-3D-Q (MPC2 Q)	MX-MPC2-3D-EQ (MPC2 EQ)
IEEE 802.1ag Ethernet OAM Linktrace protocol	10.2 (bridge family supported in 10.4)	10.2 (bridge family supported in 10.4)	10.2 (bridge family supported in 10.4)	10.2 (bridge family supported in 10.4)	10.2 (bridge family supported in 10.4)	10.2 (bridge family supported in 10.4)
IEEE 802.1ag Ethernet OAM Loopback protocol	10.2 (bridge family supported in 10.4)	10.2 (bridge family supported in 10.4)	10.2 (bridge family supported in 10.4)	10.2 (bridge family supported in 10.4)	10.2 (bridge family supported in 10.4)	10.2 (bridge family supported in 10.4)
Firewall filters	10.0R2	10.2	10.1	10.2	10.1	10.1
Flexible Ethernet encapsulation	10.0R2	10.2	10.1	10.2	10.1	10.1
Graceful Routing Engine Switchover (GRES)	10.0R2	10.2	10.1	10.2	10.1	10.1
Unified in-service software upgrade (ISSU)	–	–	–	–	–	–
Ingress Differentiated Services code point (DSCP) rewrite	10.0R2	10.2	10.1	10.2	10.1	10.1
Ingress hierarchical quality-of-service (HQoS) shaping and scheduling: • Group of virtual LANs (VLANs) level • Virtual LAN (VLAN) level • Port level	–	–	–	–	–	–
Intelligent oversubscription	10.0R2	10.2	10.1	10.2	10.1	10.1
Integrated routing and bridging (IRB)	10.1	10.2	10.1	10.2	10.1	10.1
Intermediate System-to-Intermediate System (IS-IS)	10.0R2	10.2	10.1	10.2	10.1	10.1

Table 8: Protocols and Applications Supported by the MX240, MX480, MX960 MPCs *(continued)*

Protocol or Application	First Junos OS Release Supported by MPC Model Number (MPC Name)					
	MPC-3D-16XGE-SFPP (16x10GE MPC)	MX-MPC1-3D (MPC1)	MX-MPC2-3D (MPC2)	MX-MPC1-3D-Q (MPC1 Q)	MX-MPC2-3D-Q (MPC2 Q)	MX-MPC2-3D-EQ (MPC2 EQ)
Internet Group Management Protocol (IGMP) (excluding snooping)	10.0R2	10.2	10.1	10.2	10.1	10.1
Internet Group Management Protocol (IGMP) snooping	11.4	11.4	11.4	11.4	11.4	11.4
IPv4	10.0R2	10.2	10.1	10.2	10.1	10.1
IP multicast	10.0R2	10.2	10.1	10.2	10.1	10.1
IPv6	10.2	10.2	10.2	10.2	10.2	10.2
IPv6 MLD	10.2	10.2	10.2	10.2	10.2	10.2
IPv6 multicast	10.2	10.2	10.2	10.2	10.2	10.2
IPv6 Neighbor Discovery	10.2	10.2	10.2	10.2	10.2	10.2
Label Distribution Protocol (LDP)	10.0R2	10.2	10.1	10.2	10.1	10.1
Labeled switched paths (LSPs) including accounting, policers, and filtering	10.0R2	10.2	10.1	10.2	10.1	10.1
LAN-PHY mode	10.0R2	10.2	10.1	10.2	10.1	10.1
Layer 2 frame filtering	10.0R2	10.2	10.1	10.2	10.1	10.1
IEEE 802.3ad link aggregation	10.0R2	10.2	10.1	10.2	10.1	10.1
Link Aggregation Control Protocol (LACP)	10.0R2	10.2	10.1	10.2	10.1	10.1
Local loopback	10.0R2	10.2	10.1	10.2	10.1	10.1
MAC learning, policing, accounting, and filtering	10.0R2	10.2	10.1	10.2	10.1	10.1

Table 8: Protocols and Applications Supported by the MX240, MX480, MX960 MPCs *(continued)*

Protocol or Application	First Junos OS Release Supported by MPC Model Number (MPC Name)					
	MPC-3D-16XGE-SFPP (16x10GE MPC)	MX-MPC1-3D (MPC1)	MX-MPC2-3D (MPC2)	MX-MPC1-3D-Q (MPC1 Q)	MX-MPC2-3D-Q (MPC2 Q)	MX-MPC2-3D-EQ (MPC2 EQ)
Mobile IP	–	–	–	–	–	–
Multi-chassis link aggregation	–	11.1	11.1	11.1	11.1	11.1
Multiple Tag Protocol Identifiers (TPIDs)	10.0R2	10.2	10.1	10.2	10.1	10.1
Multiprotocol Label Switching (MPLS)	10.0R2	10.2	10.1	10.2	10.1	10.1
Nonstop active routing (NSR)	10.0R2	10.2	10.1	10.2	10.1	10.1
IEEE 802.3ah OAM • Discovery and link monitoring • Fault signaling and detection • Remote loopback	10.4	10.4	10.4	10.4	10.4	10.4
Multitopology routing	10.0R2	10.2	10.1	10.2	10.1	10.1
OSPF	10.0R2	10.2	10.1	10.2	10.1	10.1
Packet mirroring	10.0R2	10.2	10.1	10.2	10.1	10.1
IEEE 802.1ah provider backbone bridges (PBB)	–	–	–	–	–	–

Table 8: Protocols and Applications Supported by the MX240, MX480, MX960 MPCs *(continued)*

Protocol or Application	First Junos OS Release Supported by MPC Model Number (MPC Name)					
	MPC-3D-16XGE-SFPP (16x10GE MPC)	MX-MPC1-3D (MPC1)	MX-MPC2-3D (MPC2)	MX-MPC1-3D-Q (MPC1 Q)	MX-MPC2-3D-Q (MPC2 Q)	MX-MPC2-3D-EQ (MPC2 EQ)
Quality of service (QoS) per port: • Eight queues per port • Excess-rate configuration at the traffic-control-profile level • Excess-rate and excess-priority configuration at the queue level • Shaping at port level • Shaping at queue level • Scheduling of queues based on weighted round-robin (WRR) per priority class • Tricolor marking • Weighted random early detection (WRED)	10.0R2	10.2	10.1	10.2	10.1	10.1
Quality of service (QoS) per virtual LAN (VLAN):						
• Accounting, filtering, and policing	10.0R2	10.2	10.1	10.2	10.1	10.1
• IEEE 802.1p rewrite	10.0R2	10.2	10.1	10.2	10.1	10.1
• Classification	10.0R2	10.2	10.1	10.2	10.1	10.1
• Excess-rate configuration at the traffic-control-profile level	–	–	–	10.2	10.1	10.1
• Excess-rate and excess-priority configuration at the queue level	–	–	–	10.2	10.1	10.1
• Tricolor marking	10.0R2	10.2	10.1	10.2	10.1	10.1
• Shaping at the queue level	–	–	–	10.2	10.1	10.1

Table 8: Protocols and Applications Supported by the MX240, MX480, MX960 MPCs *(continued)*

Protocol or Application	First Junos OS Release Supported by MPC Model Number (MPC Name)					
	MPC-3D-16XGE-SFPP (16x10GE MPC)	MX-MPC1-3D (MPC1)	MX-MPC2-3D (MPC2)	MX-MPC1-3D-Q (MPC1 Q)	MX-MPC2-3D-Q (MPC2 Q)	MX-MPC2-3D-EQ (MPC2 EQ)
• Scheduling of queues based on weighted round-robin (WRR) per priority class	–	–	–	10.2	10.1	10.1
• Weighted random early detection (WRED)	–	–	–	10.2	10.1	10.1
Quality of service (QoS) per Point-to-Point Protocol over Ethernet (PPPoE) or Dynamic Host Configuration Protocol (DHCP) subscriber interfaces:						
• Accounting, filtering, and policing	–	10.2	10.1	10.2	10.1	10.1
• IEEE 802.1p rewrite	–	10.2	10.1	10.2	10.1	10.1
• Classification	–	10.2	10.1	10.2	10.1	10.1
• Excess-rate configuration at the traffic-control-profile level	–	–	–	10.2	10.1	10.1
• Excess-rate and excess-priority configuration at the queue level	–	–	–	10.2	10.1	10.1
• Tricolor marking	–	10.2	10.1	10.2	10.1	10.1
• Shaping at the queue level	–	–	–	10.2	10.1	10.1
• Scheduling of queues based on weighted round-robin (WRR) per priority class	–	–	–	10.2	10.1	10.1
• Weighted random early detection (WRED)	–	–	–	10.2	10.1	10.1
RSVP	10.0R2	10.2	10.1	10.2	10.1	10.1

Table 8: Protocols and Applications Supported by the MX240, MX480, MX960 MPCs *(continued)*

Protocol or Application	First Junos OS Release Supported by MPC Model Number (MPC Name)					
	MPC-3D-16XGE-SFPP (16x10GE MPC)	MX-MPC1-3D (MPC1)	MX-MPC2-3D (MPC2)	MX-MPC1-3D-Q (MPC1 Q)	MX-MPC2-3D-Q (MPC2 Q)	MX-MPC2-3D-EQ (MPC2 EQ)
RIP	10.0R2	10.2	10.1	10.2	10.1	10.1
SNMP	10.0R2	10.2	10.1	10.2	10.1	10.1
Spanning Tree Protocols: • IEEE 802.1D Spanning Tree Protocol (STP) • IEEE 802.1s Multiple Spanning Tree Protocol • Per-VLAN Spanning Tree (PVST)+ • IEEE 802.1w Rapid Spanning Tree Protocol (RSTP)	10.2	10.2	10.2	10.2	10.2	10.2
Subscriber Management:						
• Aggregated Ethernet over static VLANs	–	10.2	10.1	10.2	10.1	10.1
• Aggregated Ethernet over dynamic VLANs	–	10.2	10.2	10.2	10.2	10.2
• DHCP access model	–	10.2	10.1	10.2	10.1	10.1
• Dynamic adjustment of shapers	–	10.2	10.1	10.2	10.1	10.1
• Dynamic PPPoE subscriber interface creation based on PPPoE service name table configuration	–	10.2	10.1	10.2	10.1	10.1
• Dynamic profiles	–	10.2	10.1	10.2	10.1	10.1
• Dynamic shaping, scheduling, and queuing	–	10.2	10.1	10.2	10.1	10.1
• Dynamic VLANs	–	10.2	10.2	10.2	10.2	10.2
• Static and dynamic PPPoE subscriber interfaces	–	10.2	10.1	10.2	10.1	10.1

Table 8: Protocols and Applications Supported by the MX240, MX480, MX960 MPCs *(continued)*

Protocol or Application	First Junos OS Release Supported by MPC Model Number (MPC Name)					
	MPC-3D-16XGE-SFPP (16x10GE MPC)	MX-MPC1-3D (MPC1)	MX-MPC2-3D (MPC2)	MX-MPC1-3D-Q (MPC1 Q)	MX-MPC2-3D-Q (MPC2 Q)	MX-MPC2-3D-EQ (MPC2 EQ)
Synchronous Ethernet (SyncE)	11.2R4	–	–	–	–	–
Tunnel services: • GRE unicast tunneling-Supports GRE fragmentation • IP-IP unicast tunneling • Multicast tunneling • Protocol Independent Multicast (PIM) sparse mode unicast tunneling • Virtual loopback tunneling (VT)	10.0R2	10.2	10.1	10.2	10.1	10.1
Two-Way Active Measurement Protocol (TWAMP)	10.0R2	10.2	10.1	10.2	10.1	10.1
IEEE 802.1Q VLANs: • VLAN stacking and rewriting • Channels defined by two stacked VLAN tags • Flexible VLAN tagging • IP service for nonstandard TPID and stacked VLAN tags	10.0R2	10.2	10.1	10.2	10.1	10.1
Virtual Chassis redundancy	11.2	11.2	11.2	11.2	11.2	11.2
Virtual private LAN service (VPLS)	10.0R2	10.2	10.1	10.2	10.1	10.1
Virtual private network (VPN)	10.0R2	10.2	10.1	10.2	10.1	10.1
Virtual Router Redundancy Protocol (VRRP) for IPv4	10.0R2	10.2	10.1	10.2	10.1	10.1
WAN-PHY mode	–	10.2	10.2	10.2	10.2	10.2

Protocols and Applications Supported by MX240, MX480, MX960 Enhanced MPCs (MPCE)

Table 9 on page 96 contains the first Junos OS Release support for protocols and applications on the MX240, MX480, MX960 Enhanced MPCs (MPCEs).

A dash indicates that the protocol or application is not supported.

Table 9: Protocols and Applications Supported by the MX240, MX480, MX960 Enhanced MPCs (MPCEs)

Protocol or Application	First Junos OS Release Supported by MPCE Model Number (MPCE Name)				
	MX-MPC1E-3D (MPC1E)	MX-MPC2E-3D (MPC2E)	MX-MPC1E-3D-Q (MPC1E Q)	MX-MPC2E-3D-Q (MPC2E Q)	MX-MPC2E-3D-EQ (MPC2E EQ)
Access Node Control Protocol (ANCP)	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Accepts traffic destined for GRE tunnels or DVMRP (IP-in-IP) tunnels	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Bidirectional Forwarding Detection protocol (BFD)	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Border Gateway Protocol (BGP)	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
BGP/Multiprotocol Label Switching (MPLS) virtual private networks (VPNs)	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Distance Vector Multicast Routing Protocol (DVMRP) and generic routing encapsulation (GRE) support—access side and server side	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
IEEE 802.1ag Ethernet OAM Continuity Check protocol	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
IEEE 802.1ag Ethernet OAM Linktrace protocol	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
IEEE 802.1ag Ethernet OAM Loopback protocol	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Firewall filters	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4

Table 9: Protocols and Applications Supported by the MX240, MX480, MX960 Enhanced MPCs (MPCEs) *(continued)*

Protocol or Application	First Junos OS Release Supported by MPCE Model Number (MPCE Name)				
	MX-MPC1E-3D (MPC1E)	MX-MPC2E-3D (MPC2E)	MX-MPC1E-3D-Q (MPC1E Q)	MX-MPC2E-3D-Q (MPC2E Q)	MX-MPC2E-3D-EQ (MPC2E EQ)
Flexible Ethernet encapsulation	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Graceful Routing Engine Switchover (GRES)	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Unified in-service software upgrade (ISSU)	–	–	–	–	–
Ingress Differentiated Services code point (DSCP) rewrite	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Ingress hierarchical quality-of-service (HQoS) shaping and scheduling: • Group of virtual LANs (VLANs) level • Virtual LAN (VLAN) level • Port level	–	–	–	–	–
Intelligent oversubscription	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Integrated routing and bridging (IRB)	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Intermediate System-to-Intermediate System (IS-IS)	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Internet Group Management Protocol (IGMP) (excluding snooping)	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Internet Group Management Protocol (IGMP) snooping	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
IPv4	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
IP multicast	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
IPv6	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4

Table 9: Protocols and Applications Supported by the MX240, MX480, MX960 Enhanced MPCs (MPCEs) *(continued)*

Protocol or Application	First Junos OS Release Supported by MPCE Model Number (MPCE Name)				
	MX-MPC1E-3D (MPC1E)	MX-MPC2E-3D (MPC2E)	MX-MPC1E-3D-Q (MPC1E Q)	MX-MPC2E-3D-Q (MPC2E Q)	MX-MPC2E-3D-EQ (MPC2E EQ)
IPv6 MLD	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
IPv6 multicast	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
IPv6 Neighbor Discovery	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Label Distribution Protocol (LDP)	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Labeled switched paths (LSPs) including accounting, policers, and filtering	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
LAN-PHY mode	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Layer 2 frame filtering	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
IEEE 802.3ad link aggregation	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Link Aggregation Control Protocol (LACP)	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Local loopback	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
MAC learning, policing, accounting, and filtering	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Mobile IP	–	–	–	–	–
Multi-chassis link aggregation	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Multiple Tag Protocol Identifiers (TPIDs)	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Multiprotocol Label Switching (MPLS)	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Nonstop active routing (NSR)	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4

Table 9: Protocols and Applications Supported by the MX240, MX480, MX960 Enhanced MPCs (MPCEs) *(continued)*

Protocol or Application	First Junos OS Release Supported by MPCE Model Number (MPCE Name)				
	MX-MPC1E-3D (MPC1E)	MX-MPC2E-3D (MPC2E)	MX-MPC1E-3D-Q (MPC1E Q)	MX-MPC2E-3D-Q (MPC2E Q)	MX-MPC2E-3D-EQ (MPC2E EQ)
IEEE 802.3ah OAM • Discovery and link monitoring • Fault signaling and detection • Remote loopback	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Multitopology routing	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
OSPF	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Packet mirroring	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
IEEE 802.1ah provider backbone bridges (PBB)	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Quality of service (QoS) per port: • Eight queues per port • Excess-rate configuration at the traffic-control-profile level • Excess-rate and excess-priority configuration at the queue level • Shaping at port level • Shaping at queue level • Scheduling of queues based on weighted round-robin (WRR) per priority class • Tricolor marking • Weighted random early detection (WRED)	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Quality of service (QoS) per virtual LAN (VLAN):					
• Accounting, filtering, and policing	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4

Table 9: Protocols and Applications Supported by the MX240, MX480, MX960 Enhanced MPCs (MPCEs) *(continued)*

Protocol or Application	First Junos OS Release Supported by MPCE Model Number (MPCE Name)				
	MX-MPC1E-3D (MPC1E)	MX-MPC2E-3D (MPC2E)	MX-MPC1E-3D-Q (MPC1E Q)	MX-MPC2E-3D-Q (MPC2E Q)	MX-MPC2E-3D-EQ (MPC2E EQ)
• IEEE 802.1p rewrite	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
• Classification	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
• Excess-rate configuration at the traffic-control-profile level	–	–	11.2R4	11.2R4	11.2R4
• Excess-rate and excess-priority configuration at the queue level	–	–	11.2R4	11.2R4	11.2R4
• Tricolor marking	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
• Shaping at the queue level	–	–	11.2R4	11.2R4	11.2R4
• Scheduling of queues based on weighted round-robin (WRR) per priority class	–	–	11.2R4	11.2R4	11.2R4
• Weighted random early detection (WRED)	–	–	11.2R4	11.2R4	11.2R4
Quality of service (QoS) per Point-to-Point Protocol over Ethernet (PPPoE) or Dynamic Host Configuration Protocol (DHCP) subscriber interfaces:					
• Accounting, filtering, and policing	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
• IEEE 802.1p rewrite	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
• Classification	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
• Excess-rate configuration at the traffic-control-profile level	–	–	11.2R4	11.2R4	11.2R4

Table 9: Protocols and Applications Supported by the MX240, MX480, MX960 Enhanced MPCs (MPCEs) *(continued)*

Protocol or Application	First Junos OS Release Supported by MPCE Model Number (MPCE Name)				
	MX-MPC1E-3D (MPC1E)	MX-MPC2E-3D (MPC2E)	MX-MPC1E-3D-Q (MPC1E Q)	MX-MPC2E-3D-Q (MPC2E Q)	MX-MPC2E-3D-EQ (MPC2E EQ)
• Excess-rate and excess-priority configuration at the queue level	–	–	11.2R4	11.2R4	11.2R4
• Tricolor marking	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
• Shaping at the queue level	–	–	11.2R4	11.2R4	11.2R4
• Scheduling of queues based on weighted round-robin (WRR) per priority class	–	–	11.2R4	11.2R4	11.2R4
• Weighted random early detection (WRED)	–	–	11.2R4	11.2R4	11.2R4
RSVP	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
RIP	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
SNMP	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Spanning Tree Protocols: • IEEE 802.1D Spanning Tree Protocol (STP) • IEEE 802.1s Multiple Spanning Tree Protocol • Per-VLAN Spanning Tree (PVST)+ • IEEE 802.1w Rapid Spanning Tree Protocol (RSTP)	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Subscriber Management:					
• Aggregated Ethernet over static VLANs	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
• Aggregated Ethernet over dynamic VLANs	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
• DHCP access model	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4

Table 9: Protocols and Applications Supported by the MX240, MX480, MX960 Enhanced MPCs (MPCEs) *(continued)*

Protocol or Application	First Junos OS Release Supported by MPCE Model Number (MPCE Name)				
	MX-MPC1E-3D (MPC1E)	MX-MPC2E-3D (MPC2E)	MX-MPC1E-3D-Q (MPC1E Q)	MX-MPC2E-3D-Q (MPC2E Q)	MX-MPC2E-3D-EQ (MPC2E EQ)
• Dynamic adjustment of shapers	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
• Dynamic PPPoE subscriber interface creation based on PPPoE service name table configuration	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
• Dynamic profiles	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
• Dynamic shaping, scheduling, and queuing	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
• Dynamic VLANs	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
• Static and dynamic PPPoE subscriber interfaces	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Synchronous Ethernet (SyncE)	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Tunnel services: • GRE unicast tunneling-Supports GRE fragmentation • IP-IP unicast tunneling • Multicast tunneling • Protocol Independent Multicast (PIM) sparse mode unicast tunneling • Virtual loopback tunneling (VT)	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Two-Way Active Measurement Protocol (TWAMP)	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4

Table 9: Protocols and Applications Supported by the MX240, MX480, MX960 Enhanced MPCs (MPCEs) *(continued)*

Protocol or Application	First Junos OS Release Supported by MPCE Model Number (MPCE Name)				
	MX-MPC1E-3D (MPC1E)	MX-MPC2E-3D (MPC2E)	MX-MPC1E-3D-Q (MPC1E Q)	MX-MPC2E-3D-Q (MPC2E Q)	MX-MPC2E-3D-EQ (MPC2E EQ)
IEEE 802.1Q VLANs: • VLAN stacking and rewriting • Channels defined by two stacked VLAN tags • Flexible VLAN tagging • IP service for nonstandard TPID and stacked VLAN tags	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Virtual Chassis redundancy	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Virtual private LAN service (VPLS)	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Virtual private network (VPN)	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
Virtual Router Redundancy Protocol (VRRP) for IPv4	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4
WAN-PHY mode	11.2R4	11.2R4	11.2R4	11.2R4	11.2R4

Protocols and Applications Supported by the MX240, MX480, MX960 MPC3E

Table 10 on page 103 contains the first Junos OS Release support for protocols and applications on the MX Series MPC3E. The protocols and applications support feature parity with Junos OS Release 10.4. A dash indicates that the protocol or application is not supported.

Table 10: Protocols and Applications Supported by the MX Series MPC3E

Protocol or Application	First Supported Junos OS Release
Access Node Control Protocol (ANCP)	12.1
Accepts traffic destined for generic routing encapsulation (GRE) tunnels or Distance Vector Multicast Routing Protocol (DVMRP) (IP-in-IP) tunnels • Dynamic • Manual	12.1
Bidirectional Forwarding Detection protocol (BFD)	12.1

Table 10: Protocols and Applications Supported by the MX Series MPC3E *(continued)*

Protocol or Application	First Supported Junos OS Release
Border Gateway Protocol (BGP)	12.1
Bridge Protocol Data Units (BPDUs)	-
BGP/MPLS virtual private networks (VPNs)	12.1
Class of service (CoS): • Maintain CoS across internal tunnel interfaces • Behavior aggregate (BA) classification based on 802.1p of "payload" for core-facing VPLS interfaces • BA DSCP classification of MPLS packets for L3VPN/VPLS LSI and MPLS interfaces • Rate limit option for per-port queues • BA DSCP classification for VPLS/CCC family • Configurable .1p inheritance: push and swap from the hidden tag • Maintain class/priority through logical tunnels • Configurable shaping overhead for scheduling • Configurable shaping overhead for scheduling	12.1
Class of service (CoS) per port: • Eight queues per port • Excess-rate configuration at the traffic-control-profile level • Excess-rate and excess-priority configuration at the queue level • Shaping at the port level • Shaping at the queue level • Scheduling of queues based on weighted round-robin (WRR) per priority class • Random early detection (RED) • Tricolor marking • Weighted random early detection (WRED)	12.1 NOTE: Fine-grained queuing and input queuing is not supported.
Class of service (CoS) per virtual LAN (VLAN): • Accounting, filtering, and policing • IEEE 802.1p rewrite • Classification • Excess-rate configuration at the traffic-control-profile level • Excess-rate and excess-priority configuration at the queue level • Tricolor marking • Shaping at the queue level • Scheduling of queues based on weighted round-robin (WRR) per priority class • Weighted random early detection (WRED)	12.1

Table 10: Protocols and Applications Supported by the MX Series MPC3E *(continued)*

Protocol or Application	First Supported Junos OS Release
Class of service (CoS) per Point-to-Point Protocol over Ethernet (PPPoE) or Dynamic Host Configuration Protocol (DHCP) subscriber interfaces: • Accounting, filtering, and policing • IEEE 802.1p rewrite • Classification • Excess-rate configuration at the traffic-control-profile level • Excess-rate and excess-priority configuration at the queue level • Tricolor marking • Shaping at the queue level • Scheduling of queues based on weighted round-robin (WRR) per priority class • Weighted random early detection (WRED)	12.1
DVMRP and GRE support—access side and server side	12.1
Ethernet Ring Protection Switching Overview with multiple G.8032 instances	-
IEEE 802.1ag Ethernet OAM Continuity Check protocol	-
IEEE 802.1ag Ethernet OAM Linktrace protocol	-
IEEE 802.1ag Ethernet OAM Loopback protocol	-
IEEE 802.1ag Mapped IP (MIP) support, continuity check message (CCM), stacked VLAN tagging, trunk ports, support for VPLS/VPWS, VLAN circuit cross-connect (CCC) encapsulation and transition cross-connect (TCC) encapsulation	-
IEEE 802.1ag Optional Type, Length, and Value (TLVs) support Configuring Port Status TLV and Interface Status TLV	-
IEEE 802.3ah Distributed periodic packet management process (PPM), alarm indication signal (AIS) and remote defect indication (RDI) support	-
Firewall filters and policers: • Policer support for aggregated Ethernet • Aggregate firewall-based policer for all families of a logical interface • Set forwarding class, loss priority for Routing Engine-generated packets by using a firewall • Physical interface policers, applying policer to the entire port • Lower policer limit from 32K to 8K • Egress .1p MF and BA classification for VPLS	12.1 NOTE: Packet length used for the policer included in the Layer 2 header is not supported in 12.1. NOTE: Intelligent hierarchical policers are not supported in 12.1.
Flexible Ethernet encapsulation	12.1
Graceful routing engine switchover (GRES)	–

Table 10: Protocols and Applications Supported by the MX Series MPC3E *(continued)*

Protocol or Application	First Supported Junos OS Release
IGMPv3 support with snooping disabled	12.1
Ingress Differentiated Services Code Point (DSCP) rewrite for IPv4 and IPv6	12.1
Ingress and egress hierarchical class of service (CoS) shaping and hierarchical-scheduler: • Group of virtual LANs (VLANs) level • VLAN level • Port level	–
Inline flow monitoring	12.1
Intelligent oversubscription	12.1
Integrated routing bridging (IRB)	-
Unified In-service software upgrade (ISSU)	–
Interoperability with MPCs and existing DPCs	12.1
Interoperability with Multiservices (MS) DPC	-
Interoperability with MX Flexible PIC Concentrator (MX-FPC)	-
IPv4	12.1
IPv4 multicast	12.1
IPv6	12.1
IPv6 MLD	12.1
IPv6 multicast	12.1
IPv6 Neighbor Discovery	12.1
IS-IS	12.1
ITU-T Y.1731 Timestamping support on MX	-

Table 10: Protocols and Applications Supported by the MX Series MPC3E *(continued)*

Protocol or Application	First Supported Junos OS Release
Flow monitoring and services: • Active monitoring (multiple simultaneous v8 version j-flow templates) • Active monitoring (cflowed version 9 templates) • Port mirroring family VPLS, bridge circuit cross-connect (CCC) encapsulation (VPWS) • Packet slice for port mirroring • Flow monitoring on MS-DPC • Inline flow monitoring on MPC3E	-
Labeled-switched-paths (LSPs) including accounting, policers, and filtering	12.1
LAN-PHY mode	12.1
LDP	12.1
Layer 2 features: • Frame filtering • Trunk ports • L2 forwarding support under logical systems • L2 support for MX-VC • L2/L2.5, integrated routing and bridging (IRB), and Spanning Tree Protocols (xSTP) support • 802.1 provider bridges • Layer 2 protocol tunneling (L2PT) support • Multi-chassis link aggregation group (LAG)—active/active and active/standby • Multi-chassis link aggregation group (LAG)—active/active with IGMP snooping • Link aggregation group (LAG)—VLAN-ccc encapsulation support • Internet Group Management Protocol (IGMP) snooping with bridging, IRB, and VPLS	-
Layer 2 VPN interfaces support vlan-id list	12.1

Table 10: Protocols and Applications Supported by the MX Series MPC3E *(continued)*

Protocol or Application	First Supported Junos OS Release
Layer 3 features: • IPv6 • Directed broadcast • Interoperability of PIM register message with Cisco IOS • BFD session failure action for LDP LSPs (including equal-cost multipath [ECMP]) • ASM group override of SSM ranges • Data Multicast Distribution Trees (MDTs) and subsequent address family identifier information (SAFI) • Multicast in BGP and MPLS VPNs (Draft Rosen 7, Interprovider option A) • Support local-as alias hidden command • l3vpn-composite-nexthop with eiBGP interop	12.1 NOTE: Multicast over IRB is not supported for 12.1
Link aggregation (IEEE 802.3ad)	12.1
Link Aggregation Control Protocol (LACP)	12.1
Link Layer Discovery Protocol	-
Local loopback	12.1
MAC learning, policing, accounting, and filtering	12.1
Mobile IP	-
Multichassis link aggregation	-
Multiple Tag Protocol Identifiers (TPIDs)	12.1

Table 10: Protocols and Applications Supported by the MX Series MPC3E *(continued)*

Protocol or Application	First Supported Junos OS Release
MPLS: • Switching of pseudowire segments (multisegment pseudowires with BGP-L2VPN) • LDP signaling for VPLS (LDP-VPLS) and MAC flush message processing (MAC-FLUSH-TLV) • RSVP graceful restart interop with Cisco using Nodal Hello • Failure action on BFD session down of RSVP LSPs • OSPF and IS-IS loop-free alternates (LFA) • 4/5 label MPLS operation • Virtual circuit connection verification (VCCV) BFD • VPLS instance prioritization • Point to multipoint using the enhanced-ip command (support for NG-MVPN and P2MP load balancing over aggregated Ethernet) • MPLS-FRR Bypass link protection • Load sharing across 64 ECMP next hops • MPLS-FRR VPLS instance prioritization • Supports five label stack on ingress	12.1
MPLS node-protection, link-protection, and statistics for static LSPs	-
Multiple VLAN Registration Protocol (MVRP)	-
Multitopology routing	12.1
Nonstop active routing (NSR)	12.1
OSPF	12.1
Packet mirroring	12.1
Precision time protocol (IEEE 1588)	-
IEEE 802.1ah provider backbone bridges (PBB)	
Push a tag on Ethernet VPLS and Ethernet CCC tag encapsulations	12.2
RSVP	12.1
RIP	12.1
SNMP	12.1

Table 10: Protocols and Applications Supported by the MX Series MPC3E *(continued)*

Protocol or Application	First Supported Junos OS Release
Spanning Tree Protocols: • IEEE 802.1s Multiple Spanning Tree Protocol (MSTP) (part of IEEE 802.1Q VLANs) • IEEE 802.1w Rapid Spanning Tree Protocol (RSTP) • IEEE 802.1D Spanning Tree Protocol (STP) • Per-VLAN Spanning Tree (PVST) • Bridge Protocol Data Units (BPDUs) guard and loop guard • STP inter-protocol action profiles and MAC flush (in VPLS multi-homing, flush all MACs when there is a change in the STP interface state due to root protect	-
Subscriber management: • Aggregated Ethernet over static VLANs • Aggregated Ethernet over dynamic VLANs • DHCP access model • Dynamic adjustment of shapers • Dynamic PPPoE subscriber interface creation based on PPPoE service name table configuration • Dynamic profiles • Dynamic shaping, scheduling, and queuing • Dynamic VLANs • Static and dynamic PPPoE subscriber interfaces	12.1
Synchronous Ethernet	-
Two-Way Active Measurement Protocol (TWAMP)	12.1
Tunnel services	12.1
Unnumbered Ethernet Interface	12.1
VLANs IEEE 802.1Q: • VLAN stacking and rewriting • Channels defined by two stacked VLAN tags • Flexible VLAN tagging • IP service for nonstandard TPID and stacked VLAN tags	12.1
Virtual Chassis: MPLS IPv4 and IPv6, unicast, multicast forwarding, VPLS, NSR for Layer 3/MPLS services	-

Table 10: Protocols and Applications Supported by the MX Series MPC3E *(continued)*

Protocol or Application	First Supported Junos OS Release
Virtual private LAN service (VPLS): • BGP multihoming for inter-AS VPLS • Gigabit Ethernet as core-facing interface • Configurable label block sizes • Hashing L3/L4 fields under Ethernet pseudowire for VPLS encapsulation, CCC encapsulation, and MPLS encapsulation • VPLS flood forwarding table filter (FTF), input FTF • Broadcast, unicast unknown, and multicast (BUM) traffic hashing over LAG	12.1
Virtual private network (VPN)	12.1
Virtual Router Redundancy Protocol (VRRP) for IPv4	12.1
VPLS packet flooding to the right set of interfaces across mesh groups	12.2
WAN-PHY mode	-

MX Series MICs

MX Series MIC Overview

Modular Interface Cards (MICs) install into Modular Port Concentrators (MPCs) and provide the physical connections to various network media types. MICs allow different physical interfaces to be supported on a single line card. You can install MICs of different media types on the same router as long as the router supports those MICs.

MICs receive incoming packets from the network and transmit outgoing packets to the network. During this process, each MIC performs framing and high-speed signaling for its media type. Before transmitting outgoing data packets through the MIC interfaces, the MPCs encapsulate the packets received.

MICs are hot-removable and hot-insertable. You can install up to two MICs in the slots in each MPC.

MICs Supported by MX Series Routers

Table 11 on page 112 lists the MICs supported by the MX240, MX480, and MX960 routers. Table 12 on page 113 lists the MICs supported by the MX5, MX10, MX40, and MX80 routers.

Table 11: MICs Supported by MX240, MX480, and MX960 Routers

MIC Name	MIC Model Number	Ports	First Junos OS Release
ATM			
"ATM MIC with SFP" on page 117	MIC-3D-8OC3-2OC12-ATM	8	12.1
DS3/E3			
"DS3/E3 MIC" on page 119	MIC-3D-8DS3-E3	8	11.4
Gigabit Ethernet			
"Gigabit Ethernet MIC with SFP" on page 122	MIC-3D-20GE-SFP	20	10.1

Table 11: MICs Supported by MX240, MX480, and MX960 Routers *(continued)*

MIC Name	MIC Model Number	Ports	First Junos OS Release
10-Gigabit Ethernet			
"10-Gigabit Ethernet MICs with XFP" on page 124	MIC-3D-2XGE-XFP	2	10.2
"10-Gigabit Ethernet MICs with XFP" on page 124	MIC-3D-4XGE-XFP	4	10.1
100-Gigabit Ethernet			
"100-Gigabit Ethernet MIC with CFP" on page 126	MIC3-3D-1X100GE-CFP	1	12.1
Multi-Rate			
"SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP" on page 128	MIC-3D-4OC3OC12-1OC48	4	11.2
"SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP" on page 128	MIC-3D-8OC3OC12-4OC48	8	11.2
"Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP" on page 132	MIC-3D-4CHOC3-2CHOC12	4	11.4
"Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP" on page 132	MIC-3D-8CHOC3-4CHOC12	8	11.4
Tri-Rate			
"Tri-Rate MIC" on page 136	MIC-3D-40GE-TX	40	10.2

Table 12: MICs Supported by MX5, MX10, MX40, and MX80 Routers

			First Junos OS Release			
MIC Name	MIC Model Number	Ports	MX5	MX10	MX40	MX80
ATM						
"ATM MIC with SFP" on page 117	MIC-3D-8OC3-2OC12-ATM	8	12.1	12.1	12.1	12.1
DS3/E3						
"DS3/E3 MIC" on page 119	MIC-3D-8DS3-E3	8	11.4	11.4	11.4	11.4
Gigabit Ethernet						
"Gigabit Ethernet MIC with SFP" on page 122	MIC-3D-20GE-SFP	20	11.2R4	11.2R4	11.2R4	10.2

Table 12: MICs Supported by MX5, MX10, MX40, and MX80 Routers *(continued)*

			First Junos OS Release			
MIC Name	MIC Model Number	Ports	MX5	MX10	MX40	MX80
10-Gigabit Ethernet						
"10-Gigabit Ethernet MICs with XFP" on page 124	MIC-3D-2XGE-XFP	2	11.2R4	11.2R4	11.2R4	10.2
Multi-Rate						
"SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP" on page 128	MIC-3D-4OC3OC12-1OC48	4	11.2R4	11.2R4	11.2R4	11.2
"SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP" on page 128	MIC-3D-8OC3OC12-4OC48	8	11.2R4	11.2R4	11.2R4	11.2
"Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP" on page 132	MIC-3D-4CHOC3-2CHOC12	4	11.4	11.4	11.4	11.4
"Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP" on page 132	MIC-3D-8CHOC3-4CHOC12	8	11.4	11.4	11.4	11.4
Tri-Rate						
"Tri-Rate MIC" on page 136	MIC-3D-40GE-TX	40	11.2R4	11.2R4	11.2R4	10.2

MIC/MPC Compatibility

Table 13 on page 115 and Table 14 on page 115, and Table 15 on page 116 provide a compatibility matrix for the current MICs supported by MPC1s, MPC2s, and MPC3s on MX240, MX480, and MX960 routers. The table lists the first Junos OS Release in which the MPC supports the MIC. For example, Junos OS Release 10.2 is the first release in which the MX-MPC1-3D supports the Gigabit Ethernet MIC with SFP. A dash indicates that the MIC is not supported.

Table 13: MIC/MPC1 Compatibility

MIC Name	MPC1	MPC1E	MPC1 Q	MPC1E Q
"ATM MIC with SFP" on page 117	–	–	12.1	12.1
"Gigabit Ethernet MIC with SFP (MIC-3D-20GE-SFP)" on page 122	10.2	11.2R4	10.2	11.2R4
"10-Gigabit Ethernet MICs with XFP (MIC-3D-2XGE-XFP)" on page 124	10.2	11.2R4	10.2	11.2R4
"10-Gigabit Ethernet MICs with XFP (MIC-3D-4XGE-XFP)" on page 124	—	—	—	—
"Tri-Rate MIC" on page 136	10.2	11.2R4	10.2	11.2R4
"SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP" on page 128	11.2	11.2R4	11.2	11.2R4
"Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP" on page 132	—	—	11.4	11.4
"DS3/E3 MIC" on page 119	11.4	11.4	11.4	11.4

Table 14: MIC/MPC2 Compatibility

MIC Name	MPC2	MPC2E	MPC2 Q	MPC2E Q	MPC2 EQ	MPC2E EQ
"ATM MIC with SFP" on page 117	–	–	12.1	12.1	12.1	12.1
"Gigabit Ethernet MIC with SFP (MIC-3D-20GE-SFP)" on page 122	10.1	11.2R4	10.1	11.2R4	10.1	11.2R4
"10-Gigabit Ethernet MICs with XFP (MIC-3D-2XGE-XFP)" on page 124	10.2	11.2R4	10.2	11.2R4	10.2	11.2R4
"10-Gigabit Ethernet MICs with XFP (MIC-3D-4XGE-XFP)" on page 124	10.1	11.2R4	10.1	11.2R4	10.1	11.2R4
"Tri-Rate MIC" on page 136	10.2	11.2R4	10.2	11.2R4	10.2	11.2R4

Table 14: MIC/MPC2 Compatibility *(continued)*

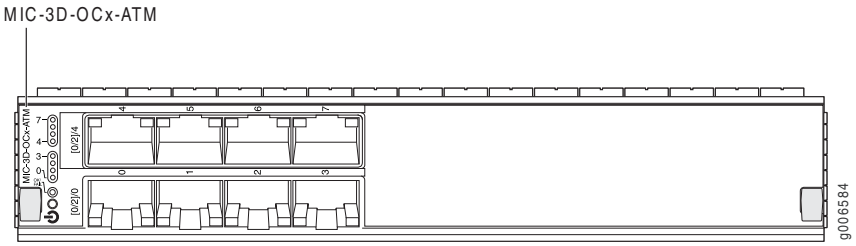
MIC Name	MPC2	MPC2E	MPC2 Q	MPC2E Q	MPC2 EQ	MPC2E EQ
"SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP" on page 128	11.2	11.2R4	11.2	11.2R4	11.2	11.2R4
"Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP" on page 132	—	—	11.4	11.4	11.4	11.4
"DS3/E3 MIC" on page 119	11.4	11.4	11.4	11.4	11.4	11.4

Table 15: MIC/MPC3 Compatibility

MIC Name	MPC3E
"Gigabit Ethernet MIC with SFP (MIC-3D-20GE-SFP)" on page 122	12.1
"100 Gigabit Ethernet MIC with CFP (MIC3-3D-1X100GE-CFP)" on page 126	12.1

ATM MIC with SFP

Figure 5: 8-Port ATM MIC with SFP



Software release	• Junos 12.1 and later

Description	• Rate-selectable using one of the following rates:
	  ◦ 8-port OC3
	  ◦ 2-port OC12
	• Power requirement: 0.73 A @ 48 V (35 W)
	• Weight: 1.2 lb (0.54 kg)
	• Model number: MIC-3D-8OC3-2OC12-ATM

Hardware features	• High-performance parsing of SONET/SDH frames • Packet segmentation and reassembly (SAR) management and output port queuing • Packet buffering, Layer 2 parsing • Line rate throughput for each port

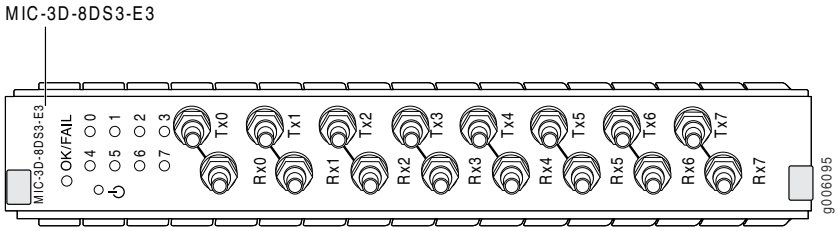
Software features	• Circuit cross-connect (CCC) for leveraging ATM access networks
	• User-configurable virtual circuit (VC) and virtual path (VP) support
	• Support for idle cell or unassigned cell transmission
	• OAM fault management processes alarm indication signal (AIS), remote defect indication (RDI) cells, and loop cells
	• Point-to-point and point-to-multipoint mode Layer 2 counters per VC and per VP
	• Local and remote loopback
	• Simple Network Management Protocol (SNMP):
	  ◦ Management Information Base (MIB) 2 (RFC 1213)
	  ◦ ATM MIB (RFC 1695)
	  ◦ SONET MIB
	  ◦ PWE3 MIB (RFC 5603)
	  ◦ PW-ATM-MIB (RFC 5605)
	  ◦ PW-FRAME-MIB (RFC 5601)
	  ◦ MIB for CoS
	• Unspecified bit rate (UBR), non-real-time variable bit rate (VBR), and constant bit rate (CBR) traffic shaping
	• Per-VC or per-VP traffic shaping
	• Support for F4 OAM cells
	• Support for 16 bit VCI range

Cables and connectors	• Duplex LC/PC connector (Rx and Tx)
	• SONET/SDH OC3/STM1 small form-factor pluggable (SFP) transceivers:
	  • Multimode (model number: SFP-OC3-SR)
	  • Intermediate reach (IR-1) (model number: SFP-OC3-IR)
	  • Long reach (LR-1) (model number: SFP-OC3-LR)
	Optical interface specifications—see SONET/SDH OC3/STM1 Optical Interface Specifications
	• SONET/SDH OC12/STM4 small form-factor pluggable (SFP) transceivers:
	  • Short reach (model number: SFP-OC12-SR)
	  • Intermediate reach (IR-1) (model number: SFP-OC12-IR)
	  • Long reach (LR-1) (model number: SFP-OC12-LR)
	Optical interface specifications—see SONET/SDH OC12/STM4 Optical Interface Specifications

LEDs	**OK/FAIL** LED, one bicolor: • Green—MIC is functioning normally. • Yellow—MIC has failed. Link LED, one green per port: • Off—No link. • On steadily—Link is up with no activity. • Blinking—Online with alarms for remote failures • Blinking rapidly—Active with a local alarm; router has detected a failure

Alarms, errors, and events	• Alarm indication signal—line (AIS-L)
	• Alarm indication signal—path (AIS-P)
	• Bit error rate—signal degrade (BERR-SD)
	• Bit error rate—signal fail (BERR-SF)
	• Loss of cell delineation (LOC)
	• Loss of frame (LOF)
	• Loss of pointer (LOP-P)
	• Loss of signal (LOS)
	• Payload mismatch (PLM-P)
	• Payload unequipped (unequipped STS at path level) (UNEQ-P)
	• Remote defect indication—line (RDI-L)
	• Remote defect indication—path (RDI-P)
	• Error detection:
	  • Bit interleaved parity errors B1, B2, B3
	  • Errored seconds (ES-S, ES-L, ES-P)
	  • Far-end bit errors, remote error indication—line (REI-L), far-end line coding violations (CV-LFE)
	  • Far-end bit errors, remote error indication—path (REI-P), far-end path coding violations (CV-PFE)
	  • Far-end errored seconds (ES-LFE, ES-PFE)
	  • Far-end severely errored seconds (SES-LFE, SES-PFE)
	  • Far-end unavailable seconds (UAS-LFE, UAS-PFE)
	  • Severely errored framing (SEF)
	  • Severely errored framing seconds (SEFS-S)
	  • Severely errored seconds (SES-S, SES-L, SES-P)
	  • Unavailable seconds (UAS-L, UAS-P)

DS3/E3 MIC



Software release	• Junos OS Release 11.4 and later

Description	• Eight E3 or DS3 ports
	• DS3/E3 MIC is available with two options:
	  ◦ 8-port DS3/E3 MIC:
	  8 clear-channel DS3 or 8 clear-channel E3 ports.
	  ◦ 8-port Channelized DS3/E3 MIC:
	  8 channelized DS3 or 8 clear-channel E3 ports.
	  You can upgrade the DS3/E3 MIC with the S-MIC-3D-8CHDS3 software license to support DS3 channelization. On the MX80 router, you also need an S-MX80-Q software license.
	• DS3 or E3 is configurable on a per-port granularity
	• DS3 channelization for the 8-port Channelized DS3/E3 MIC:
	  ◦ 8 DS3 channels
	  ◦ 224 DS1 channels
	  ◦ 2038 DS0 channels
	• Power requirement: 4.0 A @ 9 V (36W)
	• Weight: 4.4 lb (2 kg)
	• Model numbers:
	  ◦ DS3/E3 MIC: MIC-3D-8DS3-E3
	  ◦ Channelized DS3/E3 MIC: MIC-3D-8CHDS3-E3-B

Hardware features	• Ports are numbered 0 through 7, Tx0 through Tx7 and Rx0 through Rx7

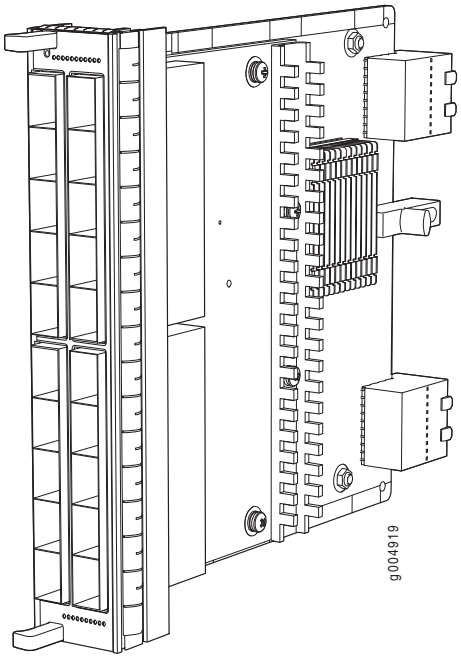
Software features	• Maximum transmission units (MTUs) of up to 9192 bytes
	• Framing: M13, C-bit parity, framed clear channel
	• Subrate and scrambling:
	NOTE: Only DS3 interfaces support subrate and scrambling.
	  • Digital Link/Quick Eagle
	  • Kentrox
	  • Larscom
	  • ADTRAN
	  • Verilink
	• Internal and look clocking
	• DS3 far-end alarm and control (FEAC) channel
	• Full bit error rate test (BERT) for DS0, DS1, and DS3
	• Encapsulations:
	  • MPLS fast reroute
	  • MPLS CCC (circuit cross-connection)
	  • MPLS TCC (translational cross-connection)
	  • Cisco High-Level Data Link Control (cHDLC)
	  • Cisco HDLC CCC
	  • Cisco HDLC TCC
	  • Point-to-Point Protocol (PPP)
	  • PPP for CCC
	  • PPP for TCC
	  • Flexible Frame Relay
	  • Frame Relay
	  • Frame Relay for CCC
	  • Frame Relay for TCC
	  • PPP over Frame Relay
	NOTE: Ethernet over Frame Relay is not supported.

Cables and connectors	• Coaxial: Custom 10-ft (3-m) mini-SMB to BNC cable (provided, model number: CBL-DS3-E3-M-S), set of 8 cables (bundled RX and TX)
LEDs	**OK/FAIL** LED, one bicolor: • Green—MIC is functioning normally • Yellow—MIC has failed Link LED, one green per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events	DS3 alarms: • Alarm indication signal (AIS) • Loss of frame (LOF) • Loss of signal seconds (LOS) • Phase lock loop (PLL) DS3 error detection: • C-bit code violations (CCV) • C-bit errored seconds (CES) • C-bit severely errored seconds (CSES) • CRC errors • Excessive zeros (EXZ) • Far-end block error (FEBE) • Far-end receive failure (FERF) • Line errored seconds (LES) • Parity bit (P-bit) code violations (PCV) • Parity bit (P-bit) errored seconds (PES) • Parity bit (P-bit) severely errored framing seconds (PSES) • Severely errored framing seconds (SEFS) • Unavailable seconds (UAS)

Gigabit Ethernet MIC with SFP

Figure 6: 20-Port Gigabit Ethernet MIC with SFP



Software release	• Junos 10.1 and later
Description	• 20 Gigabit Ethernet ports • Power requirement: 0.77 A @ 48 V (37 W) • Weight: 1.2 lb (0.54 kg) • Model number: MIC-3D-20GE-SFP
Hardware features	• High-performance throughput on each port at speeds up to 1 Gbps • Autonegotiation between Gigabit Ethernet circuit partners • Up to 20-Gbps of full-duplex traffic • Maximum transmission units (MTUs) of up to 9192 bytes
Software features	• Optical diagnostics and related alarms • Virtual Router Redundancy Protocol (VRRP) support • IEEE 802.1Q virtual LANs (VLANs) support • Remote monitoring (RMON) EtherStats • Source MAC learning • MAC accounting and policing—Dynamic local address learning of source MAC addresses • Flexible Ethernet encapsulation • Multiple tag protocol identifiers (TPID) • In-service software upgrade (ISSU) is supported in Junos 11.2 and later

Cables and connectors	• Fiber-optic small form-factor pluggable (SFP) transceivers:
	  • Connector: Duplex LC/PC (Rx and Tx)
	  • 100BASE-FX (model number: SFP-1FE-FX)
	  • 1000BASE-LH (model number: SFP-1GE-LH)
	  • 1000BASE-LX (model number: SFP-1GE-LX)
	  • 1000BASE-SX (model number: SFP-1GE-SX)
	  Optical interface specifications—see Gigabit Ethernet 1000BASE Optical Interface Specifications
	• Copper SFP transceivers:
	  • Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
	  • 1000BASE-T (model number: SFP-1GE-T)
	  • 10/100/1000BASE-T (model number: SFP-1GE-FE-E-T)
	  NOTE: SFP-1GE-FE-E-T supports tri-rate 10/100/1000 mode in Junos OS Release 9.4 and later
	  • Pinout: MDI, MDI crossover
	  • Length: 328 ft/100 m
	  Copper interface specifications—see Ethernet 10BASE-T Copper Interface Specifications, Fast Ethernet 100BASE-T Copper Interface Specifications, and Gigabit Ethernet 1000BASE-T Copper Interface Specifications
	• Bidirectional SFP transceivers:
	  • Connector: Duplex LC/PC (Rx and Tx)
	  • 1000BASE-BX (model number pairs: SFP-GE10KT13R14 with SFP-GE10KT14R13, SFP-GE10KT13R15 with SFP-GE10KT15R13, SFP-GE40KT13R15 with SFP-GE40KT15R13)
	  Optical interface specifications—see Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications

LEDs	**OK/FAIL** LED, one bicolor: • Green—MIC is functioning normally. • Yellow—MIC has failed. Link LED, one green per port: • Off—No link. • On steadily—Link is up with no activity. • Blinking—Link is up and is active.

10-Gigabit Ethernet MICs with XFP

Figure 7: 2-Port 10-Gigabit Ethernet MIC with XFP

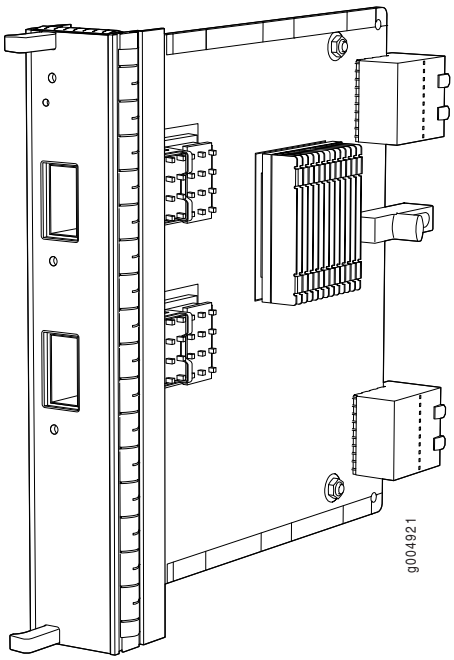
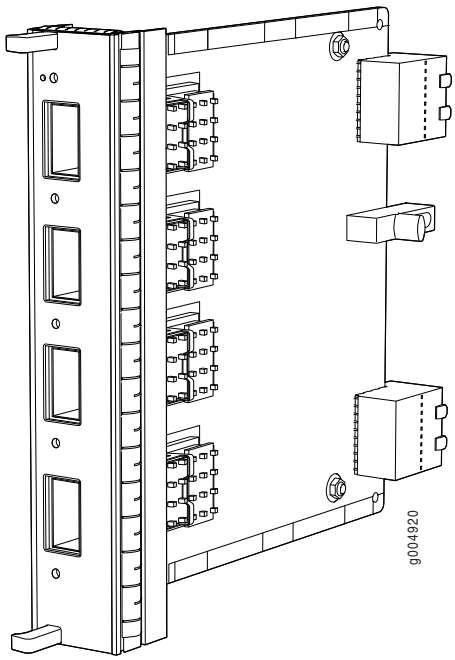


Figure 8: 4-Port 10-Gigabit Ethernet MIC with XFP



Software release	• 2-port: Junos 10.2 and later • 4-port: Junos 10.1 and later

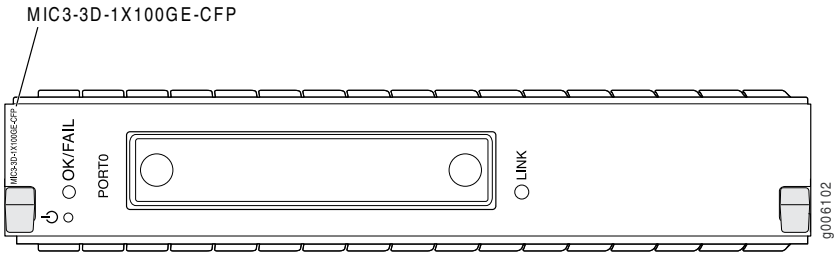
Description	• Two or four 10-Gigabit Ethernet ports
	• Power requirement:
	  ◦ 2-port: 0.6 A @ 48 V (29 W)
	  ◦ 4-port: 0.56 A @ 48 V (27 W)
	• Weight:
	  ◦ 2-port: 1 lb (0.45 kg)
	  ◦ 4-port: 1.1 lb (0.5 kg)
	• Model number:
	  ◦ 2-port: MIC-3D-2XGE-XFP
	  ◦ 4-port: MIC-3D-4XGE-XFP

Hardware features	• High-performance throughput on each port at speeds up to 10 Gbps • Up to 30-Gbps of full-duplex traffic • LAN-PHY mode at 10.3125 Gbps • WAN-PHY mode at 9.953 Gbps • Maximum transmission units (MTUs) of up to 9192 bytes

Software features	• Configurable LAN-PHY and WAN-PHY mode options • Synchronous Ethernet support • Optical diagnostics and related alarms • Virtual Router Redundancy Protocol (VRRP) support • IEEE 802.1Q virtual LANs (VLANs) support • Remote monitoring (RMON) EtherStats • Source MAC learning • MAC accounting and policing—Dynamic local address learning of source MAC addresses • Flexible Ethernet encapsulation • Multiple tag protocol identifiers (TPID)
Cables and connectors	• Fiber-optic 10-gigabit small form-factor pluggable (XFP) transceivers: ◦ Connector: Duplex LC/PC (Rx and Tx) ◦ 10GBASE-E (model number: XFP-10G-E-OC192-IR2) ◦ 10GBASE-L (model number: XFP-10G-L-OC192-SR1) ◦ 10GBASE-S (model number: XFP-10G-S) ◦ 10GBASE-Z (model number: XFP-10G-Z-OC192-LR2) Optical interface specifications—see 10-Gigabit Ethernet 10GBASE Optical Interface Specifications • DWDM Tunable XFP transceivers: ◦ Connector: Duplex LC/PC (Rx and Tx) ◦ 10GBASE-ZR (model number: XFP-10G-CBAND-T50-ZR) DWDM supported wavelengths—see 10-Gigabit Ethernet DWDM Transceiver Wavelengths NOTE: XFP-10G-CBAND-T50-ZR is supported in Junos 10.2 and later Optical interface specifications—see 10-Gigabit Ethernet 10GBASE Optical Interface Specifications
LEDs	**OK/FAIL** LED, one bicolor: • Green—MIC is functioning normally. • Yellow—MIC has failed. **LINK** LED, one green per port: • Off—No link. • On steadily—Link is up with no activity. • Blinking—Link is up and is active. The ports are labeled: • 2-port: **[0/2]0**, **[0/2]1** • 4-port: **[0/2]0**, **[0/2]1**, **[1/3]0**, and **[1/3]1**

100-Gigabit Ethernet MIC with CFP

Figure 9: 1-Port 100 Gigabit Ethernet MIC with CFP



Software release	• 12.1 and later

Description	• One 100-Gigabit Ethernet port
	• Power requirement:
	  • .83 A @ 48 V (40 W)
	• Weight:
	  • 1.94 lb (0.88 kg)
	• Model number:
	  • MIC3-3D-1X100GE-CFP

Hardware features	• High-performance throughput on each port at speeds up to 100 Gbps • Up to 100-Gbps of full-duplex traffic • Maximum transmission units (MTUs) of up to 9192 bytes
Software features	• Synchronous Ethernet support • Optical diagnostics and related alarms • Virtual Router Redundancy Protocol (VRRP) support • IEEE 802.1Q virtual LANs (VLANs) support • Remote monitoring (RMON) EtherStats • Source MAC learning • MAC accounting and policing—Dynamic local address learning of source MAC addresses • Flexible Ethernet encapsulation • Multiple tag protocol identifiers (TPID)

Cables and connectors	• Fiber-optic 100-Gigabit C Form-Factor Pluggable
	  • Connector: Duplex SC/PC (Rx and Tx)
	  • 100GBASE-LR4 (model number: CFP-100GBASE-LR4)
	Optical interface specifications—see 100-Gigabit Ethernet 100GBASE Optical Interface Specifications

LEDs	**OK/FAIL** LED, one bicolor: • Green—MIC is functioning normally. • Yellow—MIC has failed. **LINK** LED, one green per port: • Off—No link. • On steadily—Link is up with no activity. • Blinking—Link is up and is active. The port is labeled: • **[0]**

SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP

Figure 10: 4-Port SONET/SDH OC3/STM1 (Multi-Rate) MIC with SFP

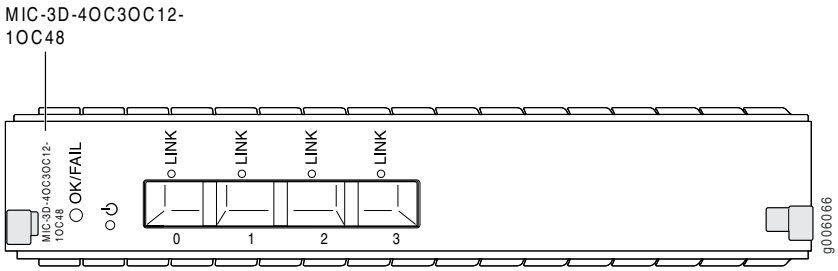
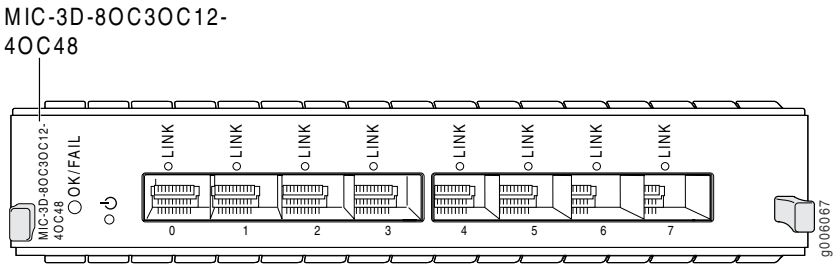


Figure 11: 8-Port SONET/SDH OC3/STM1 (Multi-Rate) MIC with SFP



Software release	• 4-port: Junos OS Release 11.2 and later • 8-port: Junos OS Release 11.2 and later

Description	• 4-port: 4 OC3/STM1 or OC12/STM4 ports
	• 8-port: 8 OC3/STM1 or OC12/STM4 ports
	• 4-port: Rate-selectable using one of the following rates:
	  ◦ 4-port OC3
	  ◦ 4-port OC12
	  ◦ 1-port OC48
	• 8-port: Rate-selectable using one of the following rates:
	  ◦ 8-port OC3
	  ◦ 8-port OC12
	  ◦ 4-port OC48
	• Power requirement:
	  ◦ 4-port: 2.6 A @ 9 V (23.4 W)
	  ◦ 8-port: 3.1 A @ 9 V (27.9 W)
	• Weight:
	  ◦ 4-port: 1.27 lb (0.58 kg)
	  ◦ 8-port: 1.47 lb (0.67 kg)
	• Model number:
	  ◦ 4-port: MIC-3D-4OC3OC12-1OC48
	  ◦ 8-port: MIC-3D-8OC3OC12-4OC48

Hardware features	• The ports are labeled:
	  • 4-port: 0-3
	  • 8-port: 0-7
	• Maximum transmission units (MTUs) of up to 9192 bytes

Software features	• Per-port SONET/SDH framing
	• Local and remote loopback on each port
	• Optical diagnostics and monitoring
	• Clocking options: internal or external/loop mode.
	• Encapsulations:
	  • Multi-Protocol Label Switching (MPLS) fast reroute
	  • MPLS CCC (Circuit Cross-Connection)
	  • MPLS TCC (Translational Cross-Connection)
	  • Cisco High-Level Data Link Control (cHDLC)
	  • cHDLC CCC
	  • cHDLC TCC
	  • Point-to-Point Protocol (PPP)
	  • PPP for CCC
	  • PPP for TCC
	  • Flexible Frame Relay
	  • Frame Relay
	  • Frame Relay for CCC
	  • Frame Relay for TCC
	  • PPP over Frame Relay
	NOTE: Ethernet over Frame Relay is not supported.

Cables and connectors	• Duplex LC/PC connector (Rx and Tx)
	• SONET/SDH OC3/STM1 small form-factor pluggable (SFP) transceivers:
	  • Multimode (model number: SFP-OC3-SR)
	  • Intermediate reach (IR-1) (model number: SFP-OC3-IR)
	  • Long reach (LR-1) (model number: SFP-OC3-LR)
	Optical interface specifications—see SONET/SDH OC3/STM1 Optical Interface Specifications
	• SONET/SDH OC12/STM4 small form-factor pluggable (SFP) transceivers:
	  • Short reach (model number: SFP-OC12-SR)
	  • Intermediate reach (IR-1) (model number: SFP-OC12-IR)
	  • Long reach (LR-1) (model number: SFP-OC12-LR)
	Optical interface specifications—see SONET/SDH OC12/STM4 Optical Interface Specifications
	• SONET/SDH OC48/STM16 small form-factor pluggable (SFP) transceivers:
	  • Multimode (model number: SFP-1OC48-SR)
	  • Intermediate reach (IR-1) (model number: SFP-1OC48-IR)
	  • Long reach (LR-1) (model number: SFP-1OC48-LR)
	Optical interface specifications—see SONET/SDH OC48/STM16 Optical Interface Specifications

LEDs	**OK/FAIL** LED, one bicolor: • Green—MIC is functioning normally • Yellow—MIC has failed **LINK** LED, one green per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events	SONET alarms: • Loss of light (LOL) • Loss of signal (LOS) • Loss of frame (LOF) • Phase lock loop (PLL) • Severely errored frame (SEF) • Alarm indicator signal–line (AIS-L) • Alarm indicator signal–path (AIS-P) • Remote defect indicator–line (RDI-L) • Remote defect indicator–path (RDI-P) • Loss of pointer–path (LOP-P) • Bit error rate–signal degrade (BERR-SD) • Bit error rate–signal fail (BERR-SF) • Payload label mismatch–Path (PLM-P) • Unequipped–path (UNEQ-P) • Remote error indicator–path (REI-P) • Alarm indicator signal–virtual container (V-AIS) • Loss of pointer–virtual container (V-LOP) • Remote defect indicator–virtual container (V-RDI) • Unequipped–virtual container (V-UNEQ) • Mismatch–virtual container (V-MIS) SDH alarms: • Loss of light (LOL) • Phase lock loop (PLL) • Loss of frame (LOF) • Loss of signal (LOS) • Severely errored frame (SEF) • Multiplex-section alarm indicator signal (MS-AIS) • H Path alarm indicator signal (HP-AIS) • Loss of pointer (LOP) • Bit error rate–signal degrade (BER-SD) • Bit error rate–signal fail (BER-SF) • Multiplex section–far end receive failure (MS-FERF) • High order path–far end receive failure (HP-FERF) • High order path–payload label mismatch (HP-PLM) • Remote error indicator (REI) • Unequipped (UNEQ) • Tributary unit–alarm indicator signal (TU-AIS) • Tributary unit–loss of pointer (TU-LOP) • Tributary unit–remote defect indicator (TU-RDI) • Tributary unit–unequipped (TU-UNEQ) • Tributary unit–mismatch (TU-MIS)

Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP

Figure 12: 4-Port Channelized SONET/SDH OC3/STM1 (Multi-Rate) MIC with SFP

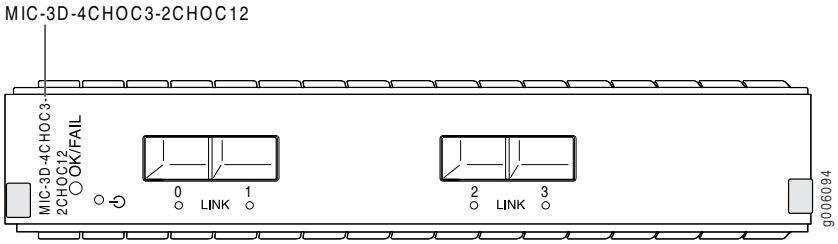
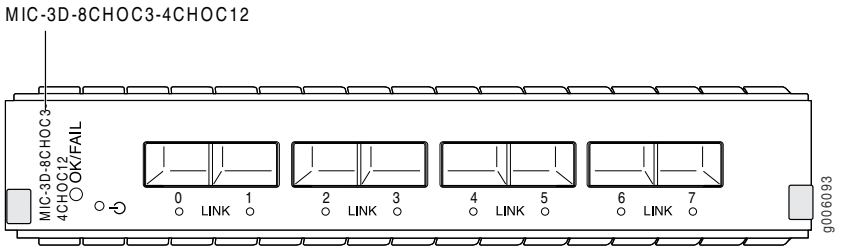


Figure 13: 8-Port Channelized SONET/SDH OC3/STM1 (Multi-Rate) MIC with SFP



Software release	• Junos OS Release 11.4 and later

Description	• 4-port: Rate-selectable using one of the following rates:
	  ◦ 4-port OC3/STM1
	  ◦ 2-port OC12/STM4
	• 8-port: Rate-selectable using one of the following rates:
	  ◦ 8-port OC3/STM1
	  ◦ 4-port OC12/STM4
	• Channelization: OC3, DS3, DS1, DS0, E3, E1
	• Power requirement:
	  ◦ 4-port: 4.56 A @ 9 V (41 W)
	  ◦ 8-port: 5.78 A @ 9 V (52 W)
	• Weight:
	  ◦ 4-port: 4.4 lb (2 kg)
	  ◦ 8-port: 4.4 lb (2 kg)
	• Model number:
	  ◦ 4-port: MIC-3D-4CHOC3-2CHOC12
	  ◦ 8-port: MIC-3D-8CHOC3-4CHOC12

Hardware features	• The ports are labeled:
	  ◦ 4-port: 0-3
	  ◦ 8-port: 0-7

Software features	• Maximum transmission units (MTUs) of up to 9192 bytes
	• Per-port SONET/SDH framing
	• Local and remote loopback on each port
	• Optical diagnostics and monitoring
	• Clocking options: internal or external/loop mode
	• Encapsulations:
	  ◦ MPLS fast reroute
	  ◦ MPLS CCC (circuit cross-connection)
	  ◦ MPLS TCC (translational cross-connection)
	  ◦ Cisco High-Level Data Link Control (cHDLC)
	  ◦ Cisco HDLC CCC
	  ◦ Cisco HDLC TCC
	  ◦ Point-to-Point Protocol (PPP)
	  ◦ PPP for CCC
	  ◦ PPP for TCC
	  ◦ Flexible Frame Relay
	  ◦ Frame Relay
	  ◦ Frame Relay for CCC
	  ◦ Frame Relay for TCC
	  ◦ PPP over Frame Relay
	NOTE: Ethernet over Frame Relay is not supported.

Cables and connectors	• Duplex LC/PC connector (Rx and Tx)
	• SONET/SDH OC3/STM1 small form-factor pluggable (SFP) transceivers:
	  ◦ Multimode (model number: SFP-OC3-SR)
	  ◦ Intermediate reach (IR-1) (model number: SFP-OC3-IR)
	  ◦ Long reach (LR-1) (model number: SFP-OC3-LR)
	Optical interface specifications—see SONET/SDH OC3/STM1 Optical Interface Specifications
	• SONET/SDH OC12/STM4 small form-factor pluggable (SFP) transceivers:
	  ◦ Short reach (model number: SFP-OC12-SR)
	  ◦ Intermediate reach (IR-1) (model number: SFP-OC12-IR)
	  ◦ Long reach (LR-1) (model number: SFP-OC12-LR)
	  ◦ Long reach (LR-2) (model number: SFP-OC12-LR2)
	Optical interface specifications—see SONET/SDH OC12/STM4 Optical Interface Specifications

LEDs	**OK/FAIL** LED, one bicolor: • Green—MIC is functioning normally • Yellow—MIC has failed **LINK** LED, one green per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events

SONET alarms:

- Loss of light (LOL)
- Loss of signal (LOS)
- Loss of frame (LOF)
- Phase lock loop (PLL)
- Severely errored frame (SEF)
- Alarm indicator signal–line (AIS-L)
- Alarm indicator signal–path (AIS-P)
- Remote defect indicator–line (RDI-L)
- Remote defect indicator–path (RDI-P)
- Loss of pointer–path (LOP-P)
- Bit error rate–signal degrade (BERR-SD)
- Bit error rate–signal fail (BERR-SF)
- Payload label mismatch–Path (PLM-P)
- Unequipped–path (UNEQ-P)
- Remote error indicator–path (REI-P)
- Alarm indicator signal–virtual container (V-AIS)
- Loss of pointer–virtual container (V-LOP)
- Remote defect indicator–virtual container (V-RDI)
- Unequipped–virtual container (V-UNEQ)
- Mismatch–virtual container (V-MIS)

SDH alarms:

- Loss of light (LOL)
- Phase lock loop (PLL)
- Loss of frame (LOF)
- Loss of signal (LOS)
- Severely errored frame (SEF)
- Multiplex-section alarm indicator signal (MS-AIS)
- Higher order path–alarm indication signal (HP-AIS)
- Loss of pointer (LOP)
- Bit error rate–signal degrade (BER-SD)
- Bit error rate–signal fail (BER-SF)
- Multiplex section–far end receive failure (MS-FERF)
- Higher order path—far-end receive failure (HP-FERF)
- Higher order path—payload label mismatch (HP-PLM)
- Remote error indicator (REI)
- Unequipped (UNEQ)
- Tributary unit–alarm indicator signal (TU-AIS)
- Tributary unit–loss of pointer (TU-LOP)
- Tributary unit–remote defect indicator (TU-RDI)
- Tributary unit–unequipped (TU-UNEQ)
- Tributary unit–mismatch (TU-MIS)

DS3 alarms:

- Alarm indication signal (AIS)
- Loss of frame (LOF)

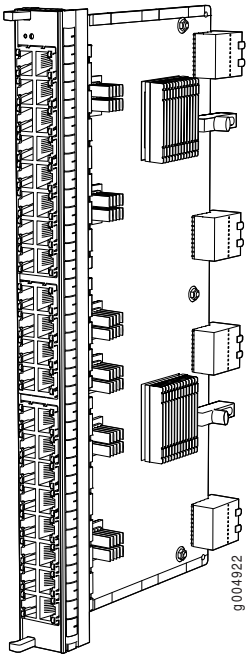
- Loss of signal seconds (LOS)
- Phase lock loop (PLL)

DS3 error detection:

- C-bit code violations (CCV)
- C-bit errored seconds (CES)
- C-bit severely errored seconds (CSES)
- CRC errors
- Excessive zeros (EXZ)
- Far-end block error (FEBE)
- Far-end receive failure (FERF)
- Line errored seconds (LES)
- Parity bit (P-bit) code violations (PCV)
- Parity bit (P-bit) errored seconds (PES)
- Parity bit (P-bit) severely errored framing seconds (PSES)
- Severely errored framing seconds (SEFS)
- Unavailable seconds (UAS)

Tri-Rate MIC

Figure 14: 40-Port Tri-Rate MIC



Software release	• Junos 10.2 and later
Description	• 40 autonegotiating 10BASE-T, 100BASE-TX, or 1000BASE-T Megabit Ethernet ports • Power requirement: 0.85 A @ 48 V (41 W) • Weight: 1.9 lb (0.9 kg) • Model number: MIC-3D-40GE-TX
Hardware features	• Dual-wide MIC that installs into 2 MIC slots • High-performance throughput on each port at speeds of 10 Mbps, 100 Mbps, or 1000 Mbps • Up to 40-Gbps of full-duplex traffic • Autonegotiation between Gigabit Ethernet circuit partners • Maximum transmission units (MTUs) of up to 9192 bytes • The ports are numbered 0/0 through 3/9 bottom to top and left to right when installed horizontally
Software features	• Synchronous Ethernet support • Virtual Router Redundancy Protocol (VRRP) support • IEEE 802.1Q virtual LANs (VLANs) support • Remote monitoring (RMON) EtherStats • Source MAC learning • MAC accounting and policing—Dynamic local address learning of source MAC addresses • Flexible Ethernet encapsulation • Multiple tag protocol identifiers (TPID)

Cables and connectors	• Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector • Pinout: MDI, MDI crossover • Maximum distance: 328 ft (100 m) CAUTION: Do not use RJ-45 cables with strain-relief boots exceeding 1.5 mm from the bottom of the connector. Cable boots that exceed this measurement can damage the port.
LEDs	OK/fail LED, one bicolor: • Green—MIC is functioning normally. • Yellow—MIC has failed. Link LED, one green per port: • Off—No link. • On steadily—Link is up with no activity. • Blinking—Link is up and is active.

MX Series PICs

MX Series PIC Overview

PICs provide the physical connection to various network media types. The PICs are inserted into a slot in a router. You can install PICs of different media types on the same router as long as the router supports those PICs.

PICs receive incoming packets from the network and transmit outgoing packets to the network. During this process, each PIC performs framing and high-speed signaling for its media type. Before transmitting outgoing data packets, the PICs encapsulate the packets received. Each PIC is equipped with a media-specific ASIC that performs control functions tailored to the PIC's media type.

Blank PICs resemble other PICs but do not provide any physical connection or activity. When a slot is not occupied by a PIC, you must insert a blank PIC to fill the empty slot and ensure proper cooling of the system.

MX240, MX480, and MX960 3D Universal Edge Routers support 2 PICs per Flexible PIC Concentrator (FPC). The maximum number of supported PICs varies per router:

- MX960 router—12 PICs
- MX480 router—6 PICs
- MX240 router—2 PICs

Related Documentation

- High Availability Features on page 139
- FPCs Supported by MX240, MX480, and MX960 Routers on page 139
- PICs Supported by MX240, MX480, and MX960 Routers on page 139

High Availability Features

High availability features include Routing Engine redundancy, graceful Routing Engine switchover (GRES), nonstop bridging, nonstop active routing, graceful restart for routing protocols, Virtual Router Redundancy Protocol (VRRP), and unified in-service software upgrade (ISSU). Some high availability features are not supported by all platforms and all PICs. For more information, see the *Junos OS High Availability Configuration Guide*.

Related Documentation

- MX Series PIC Overview on page 138
- FPCs Supported by MX240, MX480, and MX960 Routers on page 139
- PICs Supported by MX240, MX480, and MX960 Routers on page 139

FPCs Supported by MX240, MX480, and MX960 Routers

An FPC occupies two slots when installed in an MX240, MX480, or MX960 router. The maximum number of supported FPCs varies per router:

- MX960 router—6 FPCs
- MX480 router—3 FPCs
- MX240 router—1 FPC

Table 16 on page 139 lists FPCs supported by MX Series routers.

Table 16: FPCs Supported by MX Series Routers

FPC Type	FPC Name	FPC Model Number	Maximum Number of PICs Supported	Maximum Throughput per FPC (Full-duplex)	First Junos OS Release
3	FPC3	MX-FPC3	2	20 Gbps	9.4
2	FPC2	MX-FPC2	2	10 Gbps	9.5

Related Documentation

- MX Series PIC Overview on page 138
- PICs Supported by MX240, MX480, and MX960 Routers on page 139
- High Availability Features on page 139

PICs Supported by MX240, MX480, and MX960 Routers

Table 17 on page 139 lists the PICs supported by MX240, MX480, and MX960 routers.

Table 17: PICs Supported by MX240, MX480, and MX960 Routers

PIC Name	PIC Model Number	Ports	Type	First Junos OS Release
Channelized IQ PICs				

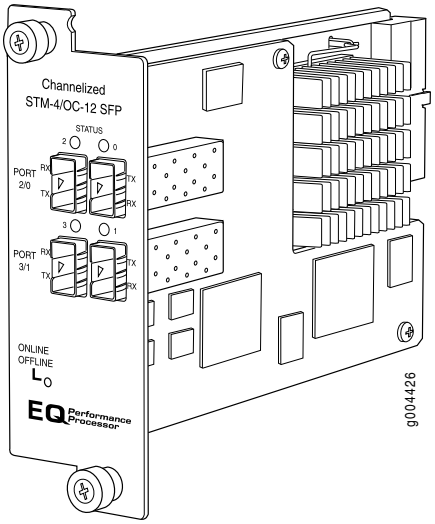
Table 17: PICs Supported by MX240, MX480, and MX960 Routers *(continued)*

PIC Name	PIC Model Number	Ports	Type	First Junos OS Release
"Channelized OC12/STM4 Enhanced IQ (IQE) PIC with SFP" on page 141	PB-4CHOC12-STM4-IQE-SFP	4	2	9.5
"Channelized OC48/STM16 Enhanced IQ (IQE) PIC with SFP" on page 146	PB-1CHOC48-STM16-IQE	1	2	9.5
SONET/SDH PICs				
"SONET/SDH OC3/STM1 (Multi-Rate) PIC with SFP" on page 151	PB-4OC3-1OC12-SON2-SFP	4	2	9.5
"SONET/SDH OC12/STM4 (Multi-Rate) PIC with SFP" on page 155	PB-4OC3-4OC12-SON-SFP	4	2	9.5
"SONET/SDH OC48/STM16 Enhanced IQ (IQE) PIC with SFP" on page 159	PC-4OC48-STM16-IQE-SFP	4	3	10.4R2
"SONET/SDH OC48/STM16 (Multi-Rate) PIC with SFP" on page 163	PB-1OC48-SON-B-SFP	1	2	9.5
"SONET/SDH OC48/STM16 PIC with SFP" on page 167	PC-4OC48-SON-SFP	4	3	9.4
"SONET/SDH OC192c/STM64 PIC" on page 171	PC-1OC192-SON-VSR	1	3	9.4
"SONET/SDH OC192c/STM64 PIC with XFP" on page 175	PC-1OC192-SON-XFP	1	3	9.4

Related Documentation

- MX Series PIC Overview on page 138
- FPCs Supported by MX240, MX480, and MX960 Routers on page 139
- High Availability Features on page 139

Channelized OC12/STM4 Enhanced IQ (IQE) PIC with SFP



Software release	• Junos 9.5 and later

Description	• Four OC12/STM4 ports
	• SONET or SDH is configurable on a per-port granularity
	• SONET channelization:
	  • 4 OC12 channel
	  • 16 OC3 channels
	  • 48 DS3 channels
	  • 672 DS1 channels
	  • 975 DS0 channels
	• SDH channelization:
	  • 4 STM4 channel
	  • 16 STM1 channels
	  • 48 E3 channels
	  • 504 E1 channels
	  • 975 DS0 channels
	• Power requirement: 1.08 A @ 48V (52 W)

Hardware features	• Ports are numbered:
	  • Top row: 2 and 0 from left to right
	  • Bottom row: 3 and 1 from left to right

Software features

- Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)
- Enhanced fine-grained queuing per logical interface. See the *Junos OS Class of Service Configuration Guide* for more information about class of service features.
- Subrate and scrambling:
  - Digital Link/Quick Eagle
  - Kentrox
  - Larscom
  - ADTRAN
  - Verilink
- Packet buffering, Layer 2 parsing
- M13/C-bit parity encoding
- DS3 far-end alarm and control (FEAC) channel support
- Local line, remote line, and remote payload loopback testing
- Simple Network Management Protocol (SNMP): OC3 MIB, DS3 MIB, T1 MIB
- Dynamic, arbitrary channel configuration
- Full bit error rate test (BERT)
- Encapsulations:
  - Circuit cross-connect (CCC)
  - Translational cross-connect (TCC)
  - Extended Frame Relay for CCC and TCC
  - Flexible Frame Relay
  - Frame Relay
  - Frame Relay for CCC
  - Frame Relay for TCC
  - Frame Relay port CCC
  - High-Level Data Link Control (HDLC)
  - HDLC framing for CCC
  - HDLC framing for TCC
  - MPLS CCC
  - MPLS TCC
  - Multilink Frame Relay (MLFR) UNI NNI (MFR FRF.16)
  - Point-to-Point Protocol (PPP)
  - PPP for CCC
  - PPP for TCC
- Encapsulations available only for DS1:
  - Multilink Frame Relay end-to-end (MLFR FRF.15)
  - Multilink PPP (MLPPP)
  - PPP over Frame Relay

Cables and connectors	• You can install any transceiver supported by the PIC. For information about installing and removing transceivers, see the hardware guide for your router.
	• SONET/SDH OC12/STM4 small form-factor pluggable (SFP) transceivers:
	  ◦ Connector: Duplex LC/PC (Rx and Tx); single-mode fiber
	  ◦ Short reach (SR-1) (model number: SFP-OC12-SR)
	  ◦ Intermediate reach (IR-1) (model number: SFP-OC12-IR)
	  ◦ Long reach (LR-1) (model number: SFP-OC12-LR)
	Optical interface specifications—see SONET/SDH OC12/STM4 Optical Interface Specifications

LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure
Alarms, errors, and events	SONET alarms: • Alarm indication signal—line (AIS-L) • Alarm indication signal—path (AIS-P) • Bit error rate—signal degrade (BERR-SD) • Bit error rate—signal fail (BERR-SF) • Loss of frame (LOF) • Loss of light (LOL) • Loss of pointer (LOP) • Loss of signal (LOS) • Payload label mismatch (PLM-P) • Remote defect indication—line (RDI-L) • Remote defect indication—path (RDI-P) • Remote error indication (REI) • Payload unequipped (unequipped STS at path level) (UNEQ-P) • Virtual container—alarm indication signal (VAIS) • Virtual container—loss of pointer (VLOP) • Virtual container—mismatch (VMIS) • Virtual container—remote defect indication (VRDI) • Virtual container—unequipped (VUNEQ)

SDH alarms:

- Administrative unit alarm indication signal (AU-AIS)
- Bit error rate—signal degrade (BERR-SD)
- Bit error rate—signal fail (BERR-SF)
- Bit interleaved parity (BIP) error B1, B2, B3
- Higher order path—alarm indication signal (HP-AIS)
- Higher order path—far-end receive failure (HP-FERF)
- Higher order path—payload label mismatch (HP-PLM)
- Higher order path—loss of pointer (HP-LOP)
- Higher order path—remote defect indication (HP-RDI)
- Higher order path—unequipped (HP-UNEQ)
- Loss of frame (LOF)
- Loss of light (LOL)
- Loss of signal (LOS)
- Multiplex section—alarm indication signal (MS-AIS)
- Multiplex section—far-end receive failure (MS-FERF)
- Multiplex section—remote defect indication (MS-RDI)
- Multiplex section—remote error indication (MS-REI)
- Phase lock loop (PLL)
- Remote error indication (REI)
- Severely errored frame (SEF)
- Tributary unit—alarm indication signal (TU-AIS)
- Tributary unit—loss of pointer (TU-LOP)
- Tributary unit—mismatch (TU-MIS)
- Tributary unit—remote defect indication (TU-RD1)
- Tributary unit—unequipped (TU-UNEQ)

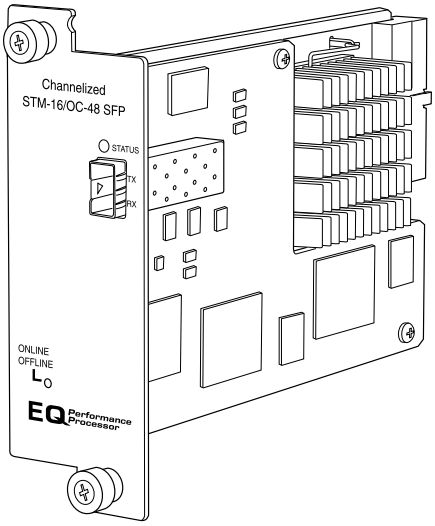
	• DS1 alarms:
	  • Alarm indication signal (AIS)
	  • Loss of frame (LOF)
	  • Remote alarm indication signal (RAIS)
	• DS1 error detection:
	  • Bursty errored seconds (BES)
	  • CRC errors
	  • Errored seconds (ES)
	  • Line errored seconds (LES)
	  • Loss of framing seconds (LOFS)
	  • Severely errored seconds (SES)
	  • Severely errored framing seconds (SEFS)
	  • Unavailable seconds (UAS)
	• DS3 alarms:
	  • Alarm indication signal (AIS)
	  • Loss of frame (LOF)
	  • Yellow alarm
	• DS3 error detection:
	  • C-bit code violations (CCV)
	  • C-bit errored seconds (CES)
	  • C-bit severely errored framing seconds (CEFS)
	  • CRC errors
	  • Excessive zeros (EXZ)
	  • Far-end block error (FEBE)
	  • Far-end receive failure (FERF)
	  • Line errored seconds (LES)
	  • Parity bit (P-bit) code violations (PCV)
	  • Parity bit (P-bit) errored seconds (PES)
	  • Parity bit (P-bit) severely errored framing seconds (PSES)
	  • Severely errored framing seconds (SEFS)
	  • Unavailable seconds (UAS)

Instrumentation (counters)	• Layer 2 per-queue and per-channel packet and byte counters

Related Documentation

- MX Series PIC Overview on page 138
- FPCs Supported by MX240, MX480, and MX960 Routers on page 139
- PICs Supported by MX240, MX480, and MX960 Routers on page 139
- High Availability Features on page 139
- SONET/SDH OC12/STM4 Optical Interface Specifications

Channelized OC48/STM16 Enhanced IQ (IQE) PIC with SFP



Software release	• Junos 9.5 and later

Description	• One OC48/STM16 port
	• SONET or SDH is configurable on a per-port granularity
	• SONET channelization:
	  • 4 OC12 channel
	  • 16 OC3 channels
	  • 48 DS3 channels
	  • 672 DS1 channels
	  • 975 DS0 channels
	• SDH channelization:
	  • 4 STM4 channel
	  • 16 STM1 channels
	  • 48 E3 channels
	  • 504 E1 channels
	  • 975 DS0 channels
	• Power requirement: 1.10 A @ 48V (53 W)

Hardware features	• Port is numbered 0.

Software features	• Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)
	• Enhanced fine-grained queuing per logical interface. See the *Junos OS Class of Service Configuration Guide* for more information about class of service features.
	• Subrate and scrambling:
	  ◦ Digital Link/Quick Eagle
	  ◦ Kentrox
	  ◦ Larscom
	  ◦ ADTRAN
	  ◦ Verilink
	• Packet buffering, Layer 2 parsing
	• M13/C-bit parity encoding
	• DS3 far-end alarm and control (FEAC) channel support
	• Local line, remote line, and remote payload loopback testing
	• Simple Network Management Protocol (SNMP): OC12, OC3 MIB, DS3 MIB, T1 MIB
	• Dynamic, arbitrary channel configuration
	• Full bit error rate test (BERT)
	• Encapsulations:
	  ◦ Circuit cross-connect (CCC)
	  ◦ Translational cross-connect (TCC)
	  ◦ Extended Frame Relay for CCC and TCC
	  ◦ Flexible Frame Relay
	  ◦ Frame Relay
	  ◦ Frame Relay for CCC
	  ◦ Frame Relay for TCC
	  ◦ Frame Relay port CCC
	  ◦ High-Level Data Link Control (HDLC)
	  ◦ HDLC framing for CCC
	  ◦ HDLC framing for TCC
	  ◦ MPLS CCC
	  ◦ MPLS TCC
	  ◦ Multilink Frame Relay (MLFR) UNI NNI (MFR FRF.16)
	  ◦ Point-to-Point Protocol (PPP)
	  ◦ PPP for CCC
	  ◦ PPP for TCC
	• Encapsulations available only for DS1:
	  ◦ Multilink Frame Relay end-to-end (MLFR FRF.15)
	  ◦ Multilink PPP (MLPPP)
	  ◦ PPP over Frame Relay

Cables and connectors	• SONET/SDH OC48/STM12 SFP small form-factor pluggable (SFP) transceivers:
	  ◦ Connector: Duplex LC/PC (Rx and Tx); single-mode fiber
	  ◦ Short reach (SR-1) (model number: SFP-1OC48-SR)
	  ◦ Intermediate reach (IR-1) (model number: SFP-1OC48-IR)
	  ◦ Long reach (LR-2) (model number: SFP-1OC48-LR)
	Optical interface specifications—see SONET/SDH OC48/STM16 Optical Interface Specifications

LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure
Alarms, errors, and events	SONET alarms: • Alarm indication signal—line (AIS-L) • Alarm indication signal—path (AIS-P) • Bit error rate—signal degrade (BERR-SD) • Bit error rate—signal fail (BERR-SF) • Loss of frame (LOF) • Loss of light (LOL) • Loss of pointer (LOP) • Loss of signal (LOS) • Payload label mismatch (PLM-P) • Remote defect indication—line (RDI-L) • Remote defect indication—path (RDI-P) • Remote error indication (REI) • Payload unequipped (unequipped STS at path level) (UNEQ-P) • Virtual container—alarm indication signal (VAIS) • Virtual container—loss of pointer (VLOP) • Virtual container—mismatch (VMIS) • Virtual container—remote defect indication (VRD1) • Virtual container—unequipped (VUNEQ)

SDH alarms:

- Administrative unit alarm indication signal (AU-AIS)
- Bit error rate—signal degrade (BERR-SD)
- Bit error rate—signal fail (BERR-SF)
- Bit interleaved parity (BIP) error B1, B2, B3
- Higher order path—alarm indication signal (HP-AIS)
- Higher order path—far-end receive failure (HP-FERF)
- Higher order path—payload label mismatch (HP-PLM)
- Higher order path—loss of pointer (HP-LOP)
- Higher order path—remote defect indication (HP-RDI)
- Higher order path—unequipped (HP-UNEQ)
- Loss of frame (LOF)
- Loss of light (LOL)
- Loss of signal (LOS)
- Multiplex section—alarm indication signal (MS-AIS)
- Multiplex section—far-end receive failure (MS-FERF)
- Multiplex section—remote defect indication (MS-RDI)
- Multiplex section—remote error indication (MS-REI)
- Phase lock loop (PLL)
- Remote error indication (REI)
- Severely errored frame (SEF)
- Tributary unit—alarm indication signal (TU-AIS)
- Tributary unit—loss of pointer (TU-LOP)
- Tributary unit—mismatch (TU-MIS)
- Tributary unit—remote defect indication (TU-RD1)
- Tributary unit—unequipped (TU-UNEQ)

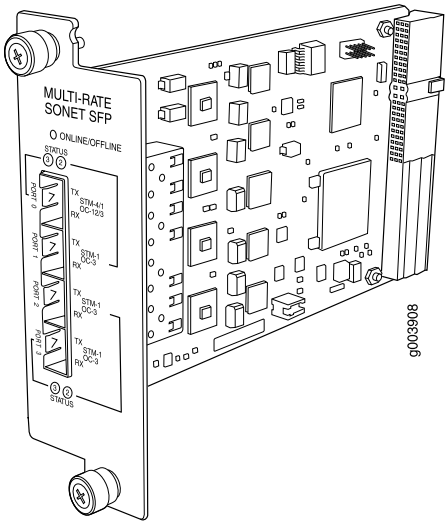
	• DS1 alarms:
	  • Alarm indication signal (AIS)
	  • Loss of frame (LOF)
	  • Remote alarm indication signal (RAIS)
	• DS1 error detection:
	  • Bursty errored seconds (BES)
	  • CRC errors
	  • Errored seconds (ES)
	  • Line errored seconds (LES)
	  • Loss of framing seconds (LOFS)
	  • Severely errored seconds (SES)
	  • Severely errored framing seconds (SEFS)
	  • Unavailable seconds (UAS)
	• DS3 alarms:
	  • Alarm indication signal (AIS)
	  • Loss of frame (LOF)
	  • Yellow alarm
	• DS3 error detection:
	  • C-bit code violations (CCV)
	  • C-bit errored seconds (CES)
	  • C-bit severely errored framing seconds (CEFS)
	  • CRC errors
	  • Excessive zeros (EXZ)
	  • Far-end block error (FEBE)
	  • Far-end receive failure (FERF)
	  • Line errored seconds (LES)
	  • Parity bit (P-bit) code violations (PCV)
	  • Parity bit (P-bit) errored seconds (PES)
	  • Parity bit (P-bit) severely errored framing seconds (PSES)
	  • Severely errored framing seconds (SEFS)
	  • Unavailable seconds (UAS)

Instrumentation (counters)	• Layer 2 per-queue and per-channel packet and byte counters

Related Documentation

- MX Series PIC Overview on page 138
- FPCs Supported by MX240, MX480, and MX960 Routers on page 139
- PICs Supported by MX240, MX480, and MX960 Routers on page 139
- High Availability Features on page 139
- SONET/SDH OC48/STM16 Optical Interface Specifications

SONET/SDH OC3/STM1 (Multi-Rate) PIC with SFP



Software release	• Junos 9.5 and later

Description	• Rate-selectable using one of the following rates:
	  ◦ 1-port OC12/STM4
	  ◦ 1-port OC12c/STM4c
	  ◦ 4-port OC3c/STM1c
	• Power requirement: 0.40 A @ 48 V (19 W)

Hardware features	• Multiplexing and demultiplexing • Rate policing on input • Rate shaping on output • Packet buffering, Layer 2 parsing

Software features	• Optical diagnostics and related alarms
	• Per-port SONET/SDH framing
	• Link aggregation
	• Alarm and event counting and detection
	• Dual-router automatic protection switching (APS)
	• Multiprotocol Label Switching (MPLS) fast reroute
	• Encapsulations:
	  ◦ Circuit cross-connect (CCC)
	  ◦ Translational cross-connect (TCC)
	  ◦ Frame Relay
	  ◦ High-Level Data Link Control (HDLC)
	  ◦ Point-to-Point Protocol (PPP)

Cables and connectors	You can install any transceiver supported by the PIC. For information about installing and removing transceivers, see the hardware guide for your router.
	• Fiber-optic small form-factor pluggable (SFP) transceivers:
	  • Connector: Duplex LC/PC (Rx and Tx)
	  • SONET/SDH OC3/STM1 SFPs:
	  • Multimode (model number: SFP-OC3-SR)
	  • Intermediate reach (IR-1) (model number: SFP-OC3-IR)
	  • Long reach (LR-1) (model number: SFP-OC3-LR)
	  Optical interface specifications—see SONET/SDH OC3/STM1 Optical Interface Specifications
	  • SONET/SDH OC12/STM4 SFPs:
	  • Short reach (SR-1) (model number: SFP-OC12-SR)
	  • Intermediate reach (IR-1) (model number: SFP-OC12-IR)
	  • Long reach (LR-1) (model number: SFP-OC12-LR)
	  Optical interface specifications—see SONET/SDH OC12/STM4 Optical Interface Specifications
	NOTE: To extend the life of the laser, when a PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. For information about taking a PIC offline, see the **request chassis pic offline** command in the *Junos OS System Basics and Services Command Reference*.

LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events

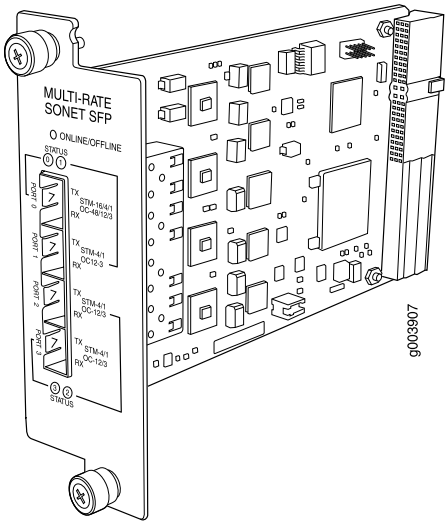
- SONET alarms:
  - Alarm indication signal—line (AIS-L)
  - Alarm indication signal—path (AIS-P)
  - Bit error rate—signal degrade (BERR-SD)
  - Bit error rate—signal fail (BERR-SF)
  - Bit interleaved parity (BIP) error B1, B2, B3
  - Far-end bit error: remote error indication—line (REI-L), far-end line coding violations (CV-LFE)
  - Far-end bit error: remote error indication—path (REI-P), far-end path coding violations (CV-PFE)
  - Loss of frame (LOF)
  - Loss of pointer (LOP-P)
  - Loss of signal (LOS)
  - Payload label mismatch (PLM-P)
  - Payload unequipped (unequipped STS at path level) (UNEQ-P)
  - Remote defect indication—line (RDI-L)
  - Remote defect indication—path (RDI-P)
- SDH alarms:
  - Administrative unit alarm indication signal (AU-AIS)
  - Bit error rate signal degrade (BERR-SD)
  - Bit error rate signal fail (BERR-SF)
  - Bit interleaved parity (BIP) error B1, B2, B3
  - Higher order path—payload label mismatch (HP-PLM)
  - Higher order path—loss of pointer (HP-LOP)
  - Higher order path—remote defect indication (HP-RDI)
  - Higher order path—unequipped (HP-UNEQ)
  - Loss of frame (LOF)
  - Loss of signal (LOS)
  - Multiplex section—alarm indication signal (MS-AIS)
  - Multiplex section—remote defect indication (MS-RDI)
  - Multiplex section—remote error indication (MS-REI)
- Error detection:
  - Errored seconds (ES-S, ES-L, ES-P)
  - Far-end errored seconds (ES-LFE, ES-PFE)
  - Far-end severely errored seconds (SES-LFE, SES-PFE)
  - Far-end unavailable seconds (UAS-LFE, UAS-PFE)
  - Severely errored frames (SEF)
  - Severely errored framing seconds (SEFS-S)
  - Severely errored seconds (SES-S, SES-L, SES-P)
  - Unavailable seconds (UAS-L, UAS-P)

Related Documentation

- MX Series PIC Overview on page 138
- FPCs Supported by MX240, MX480, and MX960 Routers on page 139
- PICs Supported by MX240, MX480, and MX960 Routers on page 139
- High Availability Features on page 139

- SONET/SDH OC3/STM1 Optical Interface Specifications
- SONET/SDH OC12/STM4 Optical Interface Specifications

SONET/SDH OC12/STM4 (Multi-Rate) PIC with SFP



Software release	• Junos 9.5 and later

Description	• Rate-selectable using one of the following rates:
	  ◦ 1-port OC12
	  ◦ 1-port OC48
	  ◦ 1-port OC48c
	  ◦ 4-port OC3c
	  ◦ 4-port OC12c
	• Power requirement: 0.40 A @ 48 V (19 W)

Hardware features	• Multiplexing and demultiplexing • Rate policing on input • Rate shaping on output • Packet buffering, Layer 2 parsing

Software features	• Optical diagnostics and related alarms
	• Per-port SONET/SDH framing
	• Link aggregation
	• Alarm and event counting and detection
	• Dual-router automatic protection switching (APS)
	• Multiprotocol Label Switching (MPLS) fast reroute
	• Encapsulations:
	  ◦ Circuit cross-connect (CCC)
	  ◦ Translational cross-connect (TCC)
	  ◦ Frame Relay
	  ◦ High-Level Data Link Control (HDLC)
	  ◦ Point-to-Point Protocol (PPP)

Cables and connectors	You can install any transceiver supported by the PIC. For information about installing and removing transceivers, see the hardware guide for your router.
	• Fiber-optic small form-factor pluggable (SFP) transceivers:
	  • Connector: Duplex LC/PC (Rx and Tx)
	  • SONET/SDH OC3/STM1 SFPs:
	  • Multimode (model number: SFP-OC3-SR)
	  • Intermediate reach (IR-1) (model number: SFP-OC3-IR)
	  • Long reach (LR-1) (model number: SFP-OC3-LR)
	  Optical interface specifications—see SONET/SDH OC3/STM1 Optical Interface Specifications
	  • SONET/SDH OC12/STM4 SFPs:
	  • Short reach (SR-1) (model number: SFP-OC12-SR)
	  • Intermediate reach (IR-1) (model number: SFP-OC12-IR)
	  • Long reach (LR-1) (model number: SFP-OC12-LR)
	  Optical interface specifications—see SONET/SDH OC12/STM4 Optical Interface Specifications
	  • SONET/SDH OC48/STM12 SFPs:
	  • Short reach (SR-1) (model number: SFP-1OC48-SR)
	  • Intermediate reach (IR-1) (model number: SFP-1OC48-IR)
	  • Long reach (LR-2) (model number: SFP-1OC48-LR)
	  Optical interface specifications—see SONET/SDH OC48/STM16 Optical Interface Specifications
	NOTE: To extend the life of the laser, when a PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. For information about taking a PIC offline, see the **request chassis pic offline** command in the *Junos OS System Basics and Services Command Reference*.

LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events

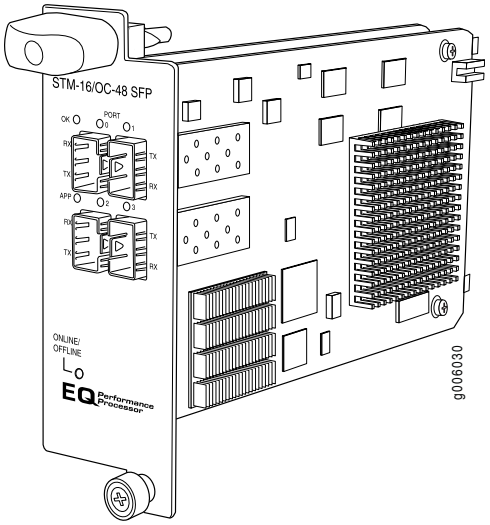
- SONET alarms:
  - Alarm indication signal—line (AIS-L)
  - Alarm indication signal—path (AIS-P)
  - Bit error rate—signal degrade (BERR-SD)
  - Bit error rate—signal fail (BERR-SF)
  - Bit interleaved parity (BIP) error B1, B2, B3
  - Far-end bit error: remote error indication—line (REI-L), far-end line coding violations (CV-LFE)
  - Far-end bit error: remote error indication—path (REI-P), far-end path coding violations (CV-PFE)
  - Loss of frame (LOF)
  - Loss of pointer (LOP-P)
  - Loss of signal (LOS)
  - Payload label mismatch (PLM-P)
  - Payload unequipped (unequipped STS at path level) (UNEQ-P)
  - Remote defect indication—line (RDI-L)
  - Remote defect indication—path (RDI-P)
- SDH alarms:
  - Administrative unit alarm indication signal (AU-AIS)
  - Bit error rate signal degrade (BERR-SD)
  - Bit error rate signal fail (BERR-SF)
  - Bit interleaved parity (BIP) error B1, B2, B3
  - Higher order path—payload label mismatch (HP-PLM)
  - Higher order path—loss of pointer (HP-LOP)
  - Higher order path—remote defect indication (HP-RDI)
  - Higher order path—unequipped (HP-UNEQ)
  - Loss of frame (LOF)
  - Loss of signal (LOS)
  - Multiplex section—alarm indication signal (MS-AIS)
  - Multiplex section—remote defect indication (MS-RDI)
  - Multiplex section—remote error indication (MS-REI)
- Error detection:
  - Errored seconds (ES-S, ES-L, ES-P)
  - Far-end errored seconds (ES-LFE, ES-PFE)
  - Far-end severely errored seconds (SES-LFE, SES-PFE)
  - Far-end unavailable seconds (UAS-LFE, UAS-PFE)
  - Severely errored frames (SEF)
  - Severely errored framing seconds (SEFS-S)
  - Severely errored seconds (SES-S, SES-L, SES-P)
  - Unavailable seconds (UAS-L, UAS-P)

Related Documentation

- MX Series PIC Overview on page 138
- FPCs Supported by MX240, MX480, and MX960 Routers on page 139
- PICs Supported by MX240, MX480, and MX960 Routers on page 139
- High Availability Features on page 139

- SONET/SDH OC3/STM1 Optical Interface Specifications
- SONET/SDH OC12/STM4 Optical Interface Specifications
- SONET/SDH OC48/STM16 Optical Interface Specifications

SONET/SDH OC48/STM16 Enhanced IQ (IQE) PIC with SFP



Software release	• Junos OS Release 10.4R2 and later (Type 3)
Description	• Four OC48/STM16 ports • Clear channel functionality • SONET and SDH is configured on a per-port granularity • Power requirement: 1.06 A @ 48 V (51 W) • Weight: 1.6 lb (0.725 kg) • Model number: PC-4OC48-STM16-IQE-SFP

Hardware features	• Ports are numbered:
	  ◦ Top row: 0 and 1 from left to right
	  ◦ Bottom row: 2 and 3 from left to right
	• Maximum transmission units (MTUs) of up to 9192 bytes

Software features	• Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)
	• Fine-grained egress queuing per logical interface. See the *Junos OS Class of Service Configuration Guide* for more information about class-of-service features
	• Packet buffering
	• Local line and remote payload loopback testing
	• Optical diagnostics and monitoring
	• Clocking options: internal or external/loop mode. Each OC48 transmitter port is configured either in internal or external mode. The default clocking option is internal mode.
	• Encapsulations:
	  • Extended Frame Relay for circuit cross-connect (CCC) and translational cross-connect (TCC)
	  • Flexible Frame Relay
	  • Frame Relay
	  • Frame Relay for CCC
	  • Frame Relay for TCC
	  • Frame Relay port CCC
	  • High-Level Data Link Control (HDLC)
	  • HDLC framing for CCC
	  • HDLC framing for TCC
	  • MPLS CCC
	  • MPLS TCC
	  • Point-to-Point Protocol (PPP)
	  • PPP for CCC
	  • PPP for TCC

Cables and connectors	You can install any transceiver supported by the PIC.
	• Duplex LC/PC connector (Rx and Tx)
	• SONET/SDH OC48/STM16 small form-factor pluggable (SFP) transceivers:
	  • Short reach (SR-1) (model number: SFP-1OC48-SR)
	  • Intermediate reach (IR-1) (model number: SFP-1OC48-IR)
	  • Long reach (LR-1) (model number: SFP-1OC48-LR)
	Optical interface specifications—see SONET/SDH OC48/STM16 Optical Interface Specifications
	NOTE: To extend the life of the laser, when a PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. For information about taking a PIC offline, see the **request chassis pic offline** command in the *Junos OS System Basics and Services Command Reference*.

LEDs	OK LED, one tricolor: • Off—PIC is offline and safe to remove from the router • Green—PIC is operating normally • Yellow—PIC is initializing • Red—PIC has an error or failure APP LED, one green per port: • Off—Service is not running • Green—Service is running under acceptable load Port LEDs, one tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events

SONET alarms:

- Loss of light (LOL)
- Phase lock loop (PLL)
- Loss of frame (LOF)
- Loss of signal (LOS)
- Severely errored frame (SEF)
- Alarm indicator signal—line (AIS-L)
- Alarm indicator signal—path (AIS-P)
- Loss of pointer (LOP)
- Bit error rate—signal degrade (BERR-SD)
- Bit error rate—signal fail (BERR-SF)
- Remote defect indicator—line (RDI-L)
- Remote defect indicator—path (RDI-P)
- Remote error indicator (REI)
- Unequipped (UNEQ)
- Payload label mismatch—path (PLM-P)

SDH alarms:

- Loss of light (LOL)
- Phase lock loop (PLL)
- Loss of frame (LOF)
- Loss of signal (LOS)
- Severely errored frame (SEF)
- Multiplex-section alarm indicator signal (MS-AIS)
- H Path alarm indicator signal (HP-AIS)
- Loss of pointer (LOP)
- Bit error rate—signal degrade (BERR-SD)
- Bit error rate—signal fail (BERR-SF)
- Multiplex section—far end receive failure (MS-FERF)
- High order path—far end receive failure (HP-FERF)
- Remote error indicator (REI)
- Unequipped (UNEQ)
- High order path—payload label mismatch - Path (HP-PLM)

Optical diagnostics related alarms:

NOTE: Transceivers from some vendors do not support these fields.

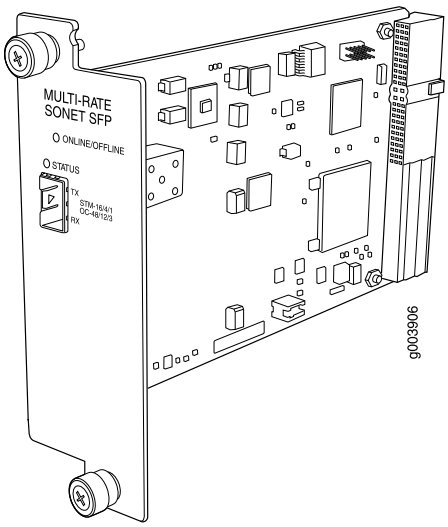
- Temperature high/low alarms and warnings
- Supply voltage high/low alarms and warnings
- Tx bias current high/low alarms and warnings
- Tx output power high/low alarms and warnings
- Rx received power high/low alarms and warnings

Related Documentation

- MX Series PIC Overview on page 138
- FPCs Supported by MX240, MX480, and MX960 Routers on page 139
- PICs Supported by MX240, MX480, and MX960 Routers on page 139

- High Availability Features on page 139
- SONET/SDH OC48/STM16 Optical Interface Specifications

SONET/SDH OC48/STM16 (Multi-Rate) PIC with SFP



Software release	• Junos 9.5 and later

Description	• Rate-selectable using one of the following rates:
	  • 1-port OC3c/STM1c
	  • 1-port OC12/STM4
	  • 1-port OC12c/STM4c
	  • 1-port OC48/STM16
	  • 1-port OC48c/STM16c
	• Power requirement: 0.20 A @ 48 V (9.5 W)

Hardware features	• Multiplexing and demultiplexing • Rate policing on input • Rate shaping on output • Packet buffering, Layer 2 parsing

Software features	• Optical diagnostics and related alarms
	• Per-port SONET/SDH framing
	• Link aggregation
	• Alarm and event counting and detection
	• Dual-router automatic protection switching (APS)
	• Multiprotocol Label Switching (MPLS) fast reroute
	• Encapsulations:
	  • Circuit cross-connect (CCC)
	  • Translational cross-connect (TCC)
	  • Frame Relay
	  • High-Level Data Link Control (HDLC)
	  • Point-to-Point Protocol (PPP)

Cables and connectors	You can install any transceiver supported by the PIC. For information about installing and removing transceivers, see the hardware guide for your router.
	
	• Fiber-optic small form-factor pluggable (SFP) transceivers:
	  • Connector: Duplex LC/PC (Rx and Tx)
	  • SONET/SDH OC3/STM1 SFPs:
	  • Multimode (model number: SFP-OC3-SR)
	  • Intermediate reach (IR-1) (model number: SFP-OC3-IR)
	  • Long reach (LR-1) (model number: SFP-OC3-LR)
	  Optical interface specifications—see SONET/SDH OC3/STM1 Optical Interface Specifications
	  • SONET/SDH OC12/STM4 SFPs:
	  • Short reach (SR-1) (model number: SFP-OC12-SR)
	  • Intermediate reach (IR-1) (model number: SFP-OC12-IR)
	  • Long reach (LR-1) (model number: SFP-OC12-LR)
	  Optical interface specifications—see SONET/SDH OC12/STM4 Optical Interface Specifications
	  • SONET/SDH OC48/STM12 SFPs:
	  • Short reach (SR-1) (model number: SFP-1OC48-SR)
	  • Intermediate reach (IR-1) (model number: SFP-1OC48-IR)
	  • Long reach (LR-2) (model number: SFP-1OC48-LR)
	  Optical interface specifications—see SONET/SDH OC48/STM16 Optical Interface Specifications
	
	NOTE: To extend the life of the laser, when a PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. For information about taking a PIC offline, see the **request chassis pic offline** command in the *Junos OS System Basics and Services Command Reference*.

LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events

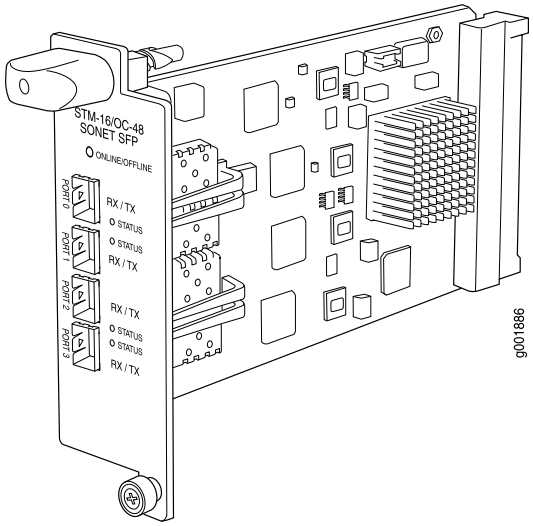
- SONET alarms:
  - Alarm indication signal—line (AIS-L)
  - Alarm indication signal—path (AIS-P)
  - Bit error rate—signal degrade (BERR-SD)
  - Bit error rate—signal fail (BERR-SF)
  - Bit interleaved parity (BIP) error B1, B2, B3
  - Far-end bit error: remote error indication—line (REI-L), far-end line coding violations (CV-LFE)
  - Far-end bit error: remote error indication—path (REI-P), far-end path coding violations (CV-PFE)
  - Loss of frame (LOF)
  - Loss of pointer (LOP-P)
  - Loss of signal (LOS)
  - Payload label mismatch (PLM-P)
  - Payload unequipped (unequipped STS at path level) (UNEQ-P)
  - Remote defect indication—line (RDI-L)
  - Remote defect indication—path (RDI-P)
- SDH alarms:
  - Administrative unit alarm indication signal (AU-AIS)
  - Bit error rate signal degrade (BERR-SD)
  - Bit error rate signal fail (BERR-SF)
  - Bit interleaved parity (BIP) error B1, B2, B3
  - Higher order path—payload label mismatch (HP-PLM)
  - Higher order path—loss of pointer (HP-LOP)
  - Higher order path—remote defect indication (HP-RDI)
  - Higher order path—unequipped (HP-UNEQ)
  - Loss of frame (LOF)
  - Loss of signal (LOS)
  - Multiplex section—alarm indication signal (MS-AIS)
  - Multiplex section—remote defect indication (MS-RDI)
  - Multiplex section—remote error indication (MS-REI)
- Error detection:
  - Errored seconds (ES-S, ES-L, ES-P)
  - Far-end errored seconds (ES-LFE, ES-PFE)
  - Far-end severely errored seconds (SES-LFE, SES-PFE)
  - Far-end unavailable seconds (UAS-LFE, UAS-PFE)
  - Severely errored frames (SEF)
  - Severely errored framing seconds (SEFS-S)
  - Severely errored seconds (SES-S, SES-L, SES-P)
  - Unavailable seconds (UAS-L, UAS-P)

Related Documentation

- MX Series PIC Overview on page 138
- FPCs Supported by MX240, MX480, and MX960 Routers on page 139
- PICs Supported by MX240, MX480, and MX960 Routers on page 139
- High Availability Features on page 139

- SONET/SDH OC3/STM1 Optical Interface Specifications
- SONET/SDH OC12/STM4 Optical Interface Specifications
- SONET/SDH OC48/STM16 Optical Interface Specifications

SONET/SDH OC48/STM16 PIC with SFP



Software release	• Junos 9.4 and later
Description	• Four OC48 ports • Power requirement: 0.86 A @ 48 V (41.4 W)
Hardware features	• Rate policing on input • Rate shaping on output • Packet buffering, Layer 2 parsing

Software features	• Optical diagnostics and related alarms
	• Configuration of SONET or SDH framing on a per-port basis
	• SONET/SDH framing
	• Link aggregation
	• Alarm and event counting and detection
	• Dual-router automatic protection switching (APS)
	• Multiprotocol Label Switching (MPLS) fast reroute
	• Encapsulations:
	  ◦ High-Level Data Link Control (HDLC)
	  ◦ Frame Relay
	  ◦ Circuit cross-connect (CCC)
	  ◦ Translational cross-connect (TCC)
	  ◦ Point-to-Point Protocol (PPP)

Cables and connectors	You can install any transceiver supported by the PIC. For information about installing and removing transceivers, see the hardware guide for your router.
	• SONET/SDH OC48/STM12 small form-factor pluggable (SFP) transceivers:
	  • Connector: Duplex LC/PC (Rx and Tx)
	  • Short reach (SR-1) (model number: SFP-1OC48-SR)
	  • Intermediate reach (IR-1) (model number: SFP-1OC48-IR)
	  • Long reach (LR-2) (model number: SFP-1OC48-LR)
	Optical interface specifications—see SONET/SDH OC12/STM4 Optical Interface Specifications
	NOTE: To extend the life of the laser, when a PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. For information about taking a PIC offline, see the **request chassis pic offline** command in the *Junos OS System Basics and Services Command Reference*.

LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events

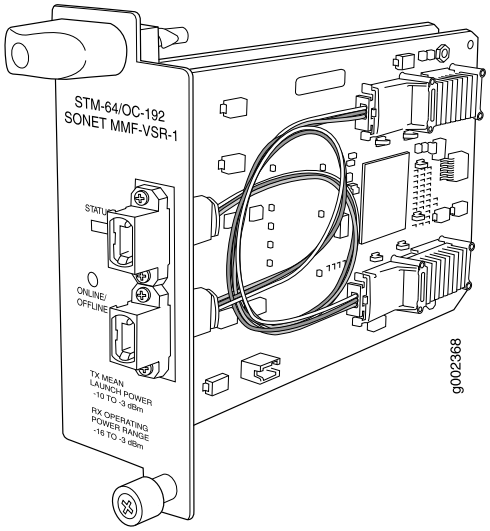
- SONET alarms:
  - Alarm indication signal—line (AIS-L)
  - Alarm indication signal—path (AIS-P)
  - Bit error rate—signal degrade (BERR-SD)
  - Bit error rate—signal fail (BERR-SF)
  - Bit interleaved parity (BIP) error B1, B2, B3
  - Far-end bit error: remote error indication—line (REI-L), far-end line coding violations (CV-LFE)
  - Far-end bit error: remote error indication—path (REI-P), far-end path coding violations (CV-PFE)
  - Loss of frame (LOF)
  - Loss of pointer (LOP-P)
  - Loss of signal (LOS)
  - Payload label mismatch (PLM-P)
  - Payload unequipped (unequipped STS at path level) (UNEQ-P)
  - Remote defect indication—line (RDI-L)
  - Remote defect indication—path (RDI-P)
- SDH alarms:
  - Administrative unit alarm indication signal (AU-AIS)
  - Bit error rate signal degrade (BERR-SD)
  - Bit error rate signal fail (BERR-SF)
  - Bit interleaved parity (BIP) error B1, B2, B3
  - Higher order path—payload label mismatch (HP-PLM)
  - Higher order path—loss of pointer (HP-LOP)
  - Higher order path—remote defect indication (HP-RDI)
  - Higher order path—unequipped (HP-UNEQ)
  - Loss of frame (LOF)
  - Loss of signal (LOS)
  - Multiplex section—alarm indication signal (MS-AIS)
  - Multiplex section—remote defect indication (MS-RDI)
  - Multiplex section—remote error indication (MS-REI)
- Error detection:
  - Errored seconds (ES-S, ES-L, ES-P)
  - Far-end errored seconds (ES-LFE, ES-PFE)
  - Far-end severely errored seconds (SES-LFE, SES-PFE)
  - Far-end unavailable seconds (UAS-LFE, UAS-PFE)
  - Severely errored framing (SEF)
  - Severely errored framing seconds (SEFS-S)
  - Severely errored seconds (SES-S, SES-L, SES-P)
  - Unavailable seconds (UAS-L, UAS-P)

Related Documentation

- MX Series PIC Overview on page 138
- FPCs Supported by MX240, MX480, and MX960 Routers on page 139
- PICs Supported by MX240, MX480, and MX960 Routers on page 139
- High Availability Features on page 139

- SONET/SDH OC48/STM16 Optical Interface Specifications

SONET/SDH OC192c/STM64 PIC



Software release	• Junos 9.4 and later
Description	• One OC192 port • Power requirement: 0.45 A @ 48 V (21.6 W)
Hardware features	• Multiplexing and demultiplexing • Rate policing on input • Rate shaping on output • Packet buffering, Layer 2 parsing

Software features	• SONET/SDH framing
	• Link aggregation
	• Alarm and event counting and detection
	• Dual-router automatic protection switching (APS)
	• Multiprotocol Label Switching (MPLS) fast reroute
	• Encapsulations:
	  ◦ High-Level Data Link Control (HDLC)
	  ◦ Frame Relay
	  ◦ Circuit cross-connect (CCC)
	  ◦ Translational cross-connect (TCC)
	  ◦ Point-to-Point Protocol (PPP)

Cables and connectors	• Very short reach (VSR 1): 12-ribbon multimode fiber with MTP connector (Rx and Tx) • Fiber-optic 10-gigabit small form-factor pluggable (XFP) transceivers: 10GBASE-S very short reach (VSR-1) (model number: XFP-10G-S) • Optical interface specifications—see 10-Gigabit Ethernet 10GBASE Optical Interface Specifications NOTE: To extend the life of the laser, when a PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. For information about taking a PIC offline, see the **request chassis pic offline** command in the *Junos OS System Basics and Services Command Reference*.
LEDs	One tricolor LED per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events

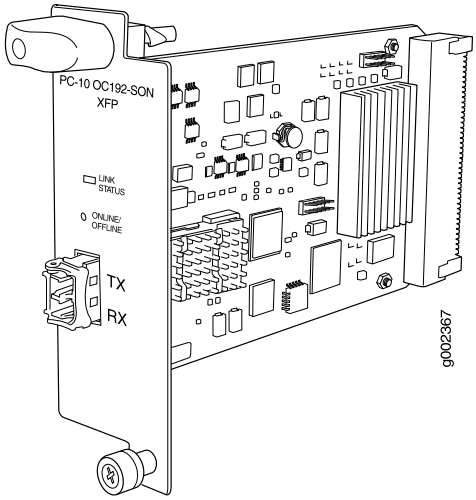
- SONET alarms:
  - Alarm indication signal—line (AIS-L)
  - Alarm indication signal—path (AIS-P)
  - Bit error rate—signal degrade (BERR-SD)
  - Bit error rate—signal fail (BERR-SF)
  - Bit interleaved parity (BIP) error B1, B2, B3
  - Far-end bit error: remote error indication—line (REI-L), far-end line coding violations (CV-LFE)
  - Far-end bit error: remote error indication—path (REI-P), far-end path coding violations (CV-PFE)
  - Loss of frame (LOF)
  - Loss of pointer (LOP-P)
  - Loss of signal (LOS)
  - Payload label mismatch (PLM-P)
  - Payload unequipped (unequipped STS at path level) (UNEQ-P)
  - Remote defect indication—line (RDI-L)
  - Remote defect indication—path (RDI-P)
- SDH alarms:
  - Administrative unit alarm indication signal (AU-AIS)
  - Bit error rate signal degrade (BERR-SD)
  - Bit error rate signal fail (BERR-SF)
  - Bit interleaved parity (BIP) error B1, B2, B3
  - Higher order path—payload label mismatch (HP-PLM)
  - Higher order path—loss of pointer (HP-LOP)
  - Higher order path—remote defect indication (HP-RDI)
  - Higher order path—unequipped (HP-UNEQ)
  - Loss of frame (LOF)
  - Loss of signal (LOS)
  - Multiplex section—alarm indication signal (MS-AIS)
  - Multiplex section—remote defect indication (MS-RDI)
  - Multiplex section—remote error indication (MS-REI)
- Error detection:
  - Errored seconds (ES-S, ES-L, ES-P)
  - Far-end errored seconds (ES-LFE, ES-PFE)
  - Far-end severely errored seconds (SES-LFE, SES-PFE)
  - Far-end unavailable seconds (UAS-LFE, UAS-PFE)
  - Severely errored framing (SEF)
  - Severely errored framing seconds (SEFS-S)
  - Severely errored seconds (SES-S, SES-L, SES-P)
  - Unavailable seconds (UAS-L, UAS-P)

Related Documentation

- MX Series PIC Overview on page 138
- FPCs Supported by MX240, MX480, and MX960 Routers on page 139
- PICs Supported by MX240, MX480, and MX960 Routers on page 139
- High Availability Features on page 139

- 10-Gigabit Ethernet 10GBASE Optical Interface Specifications

SONET/SDH OC192c/STM64 PIC with XFP



Software release	• Junos 9.4 and later
Description	• One OC192 port • Power requirement: 0.52A @ 48 V (25 W)
Hardware features	• Multiplexing and demultiplexing • Rate policing on input • Rate shaping on output • Packet buffering, Layer 2 parsing

Software features	• SONET/SDH framing
	• Link aggregation
	• Alarm and event counting and detection
	• Dual-router automatic protection switching (APS)
	• Multiprotocol Label Switching (MPLS) fast reroute
	• Encapsulations:
	  ◦ Circuit cross-connect (CCC)
	  ◦ Translational cross-connect (TCC)
	  ◦ Frame Relay
	  ◦ High-Level Data Link Control (HDLC)
	  ◦ Point-to-Point Protocol (PPP)

Cables and connectors	• Fiber-optic 10-gigabit small form-factor pluggable (XFP) transceivers:
	  • Connector: Duplex LC/PC (Rx and Tx)
	  • Short reach (SR-1) (model number: XFP-10G-L-OC192-SR1)
	  • Intermediate reach (IR-2) (model number: XFP-10G-E-OC192-IR2)
	  • Long reach (LR-2) (model number: XFP-10G-Z-OC192-LR2)
	Optical interface specifications—see SONET/SDH OC192/STM64 Optical Interface Specifications
	
	NOTE: To extend the life of the laser, when a PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. For information about taking a PIC offline, see the **request chassis pic offline** command in the *Junos OS System Basics and Services Command Reference*.

LEDs	One tricolor LED per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events	• SONET alarms:
	  • Alarm indication signal—line (AIS-L)
	  • Alarm indication signal—path (AIS-P)
	  • Bit error rate—signal degrade (BERR-SD)
	  • Bit error rate—signal fail (BERR-SF)
	  • Bit interleaved parity (BIP) error B1, B2, B3
	  • Far-end bit error: remote error indication—line (REI-L), far-end line coding violations (CV-LFE)
	  • Far-end bit error: remote error indication—path (REI-P), far-end path coding violations (CV-PFE)
	  • Loss of frame (LOF)
	  • Loss of pointer (LOP-P)
	  • Loss of signal (LOS)
	  • Payload label mismatch (PLM-P)
	  • Payload unequipped (unequipped STS at path level) (UNEQ-P)
	  • Remote defect indication—line (RDI-L)
	  • Remote defect indication—path (RDI-P)
	• SDH alarms:
	  • Administrative unit alarm indication signal (AU-AIS)
	  • Bit error rate signal degrade (BERR-SD)
	  • Bit error rate signal fail (BERR-SF)
	  • Bit interleaved parity (BIP) error B1, B2, B3
	  • Higher order path—payload label mismatch (HP-PLM)
	  • Higher order path—loss of pointer (HP-LOP)
	  • Higher order path—remote defect indication (HP-RDI)
	  • Higher order path—unequipped (HP-UNEQ)
	  • Loss of frame (LOF)
	  • Loss of signal (LOS)
	  • Multiplex section—alarm indication signal (MS-AIS)
	  • Multiplex section—remote defect indication (MS-RDI)
	  • Multiplex section—remote error indication (MS-REI)
	• Error detection:
	  • Errored seconds (ES-S, ES-L, ES-P)
	  • Far-end errored seconds (ES-LFE, ES-PFE)
	  • Far-end severely errored seconds (SES-LFE, SES-PFE)
	  • Far-end unavailable seconds (UAS-LFE, UAS-PFE)
	  • Severely errored framing (SEF)
	  • Severely errored framing seconds (SEFS-S)
	  • Severely errored seconds (SES-S, SES-L, SES-P)
	  • Unavailable seconds (UAS-L, UAS-P)

Related Documentation

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- High Availability Features on page 139

- 10-Gigabit Ethernet 10GBASE Optical Interface Specifications

Junos Documentation and Release Notes

For a list of related Junos documentation, see http://www.juniper.net/techpubs/software/junos/ .

If the information in the latest release notes differs from the information in the documentation, follow the *Junos Release Notes.*

To obtain the most current version of all Juniper Networks® technical documentation, see the product documentation page on the Juniper Networks website at http://www.juniper.net/techpubs/ .

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 post-sales 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/us/en/local/pdf/resource-guides/7100059-en.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: 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, see http://www.juniper.net/support/requesting-support.html .

Revision History

April 2012—Corrected MIC support on the MPC3E.

March 2012—Added new MPC3E. Added new ATM MIC. Added new 100-Gigabit Ethernet MIC with CFP. Corrected SFP-1GE-T support.

December 2011—Added new DS3/E3 MIC. Added new SONET/SDH OC3/STM1 (Multi-Rate) MIC.

December 2011—Added new MX5, MX10, and MX40 routers. Added new enhanced MPCs (MPCE).

September 2011—Added new 4-port and 8-port Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs.

March 2011—Updated optical specifications links.

November 2010—Updated feature tables. Corrected pinouts for copper SFPs.

August 2010—Updated information for EOL DPCs (DPC-R-4XGE-XFP and DPC-R-40GE-SFP).

June 2010—Minor updates.

May 2010—Added new 30-Gigabit Ethernet MPCs. Added new 2-port 10-Gigabit Ethernet MIC with XFP and 40-port Tri-Rate MIC. Added tunable DWDM XFP.

January 2010—Initial release.