M40e Multiservice Edge Router PIC Guide

March 2011

This guide provides an overview and description of the PICs supported by the Juniper Networks M40e Multiservice Edge Router.

Contents

M40e PICs Description

PICs physically connect the M40e Multiservice Edge Router to network media. They are housed in Flexible PIC Concentrators (FPCs).

PICs receive incoming packets from the network and transmit outgoing packets to the network, performing framing and line-speed signaling for their media type as required. PICs also encapsulate outgoing packets received from the FPCs before transmitting them. The controller ASIC on each PIC performs additional control functions specific to the PIC media type.

The router supports various PICs, including ATM, Channelized, Gigabit Ethernet, IP Services, and SONET/SDH interfaces.

Some PICs accept small form-factor pluggables (SFPs), which are fiber-optic transceivers that can be removed from the PIC. Various SFPs have different reach characteristics. You can mix them in a single PIC and change the combination dynamically. SFPs are hot-removable and hot-insertable. ,

M40e PIC Slots

The number of ports on a PIC depends on the type of PIC. You can install up to four PICs in each Type 1 FPC and one PIC in each Type 2 FPC. 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.

PICs installed on Type 1 FPCs and Type 2 FPCs are hot-removable and hot-insertable.

M40e PIC Components

Most PICs supported on the M40e Multiservice Edge Router have the following components:

- One or more cable connector ports—Accept a network media connector.
- LEDs—Indicate PIC status. Most PICs have an LED labeled **STATUS** on the PIC faceplate. Some PICs have additional LEDs, often one per port. The meaning of the LED states differs for various PICs. See each PIC description for more information about the LEDs.
- Offline button—Prepares the PIC for removal from the FPC when pressed.
  - Type 1 PICs—The offline button for each PIC is next to it on the FPC.
  - Type 2 PICs—The offline button is on the PIC faceplate.

Related Documentation

- M40e Flexible PIC Concentrators (FPCs) Description
- M40e PICs Supported on page 6.
- M40e EOL PICs Supported
- M40e Field-Replaceable Units (FRUs)
- Replacing an SFP in an M40e PIC

- Connecting the M40e PIC Cables
- Troubleshooting PICs on the M40e Router
- Replacing a PIC in an M40e Router

High Availability Features (M40e Router)

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 information about the first supported Junos OS Release for these features by PIC and platform, see the *Junos OS High Availability Configuration Guide*.

Related Documentation

- M40e PICs Description on page 3
- M40e PICs Supported on page 6

M40e PICs Supported

Table 1 on page 6 lists the PICs supported by the M40e router by PIC family. The PICs are listed alphabetically by PIC family.

Table 1: PICs Supported by the M40e Router

PIC Family and Type	Ports	Model Number	Connectors	First Junos OS Release Support
ATM2 IQ				
"ATM2 DS3 IQ PIC (M40e Router)" on page 21	4	PB-4DS3-ATM2	Coaxial: • 10 ft (3.05 m) posilock SMB to BNC (provided) • Four pairs of Rx and Tx coaxial cables	6.1
"ATM2 E3 IQ PIC (M40e Router)" on page 23	4	PB-2E3-ATM2	Coaxial: • 10 ft (3.05 m) posilock SMB to BNC cable (provided) • Four pairs of Rx and Tx coaxial cables	6.1
"ATM2 OC3/STM1 IQ PIC (M40e Router)" on page 25	2	PB-2OC3-ATM2-MM PB-2OC3-ATM2-SMIR	• Optical: SC/PC	5.5
"ATM2 OC12/STM4 IQ PICs (M40e Router)" on page 28				
• ATM2 OC12/STM4 IQ PIC	1	PB-1OC12-ATM2-MM PB-1OC12-ATM2-SMIR	• Optical: SC/PC	5.5
• ATM2 OC12/STM4 IQ PIC	2	PB-2OC12-ATM2-MM PB-2OC12-ATM2-SMIR	• Optical: SC/PC	5.5
"ATM2 OC48/STM16 IQ PIC with SFP (M40e Router)" on page 31	1	PB-1OC48-ATM2-SFP	• Optical: LC/PC	7.3
Channelized				
"Channelized OC12 PIC (M40e Router)" on page 55	1	PB-1CHOC12DS3-SMIR	• Optical: SC/PC	5.2

Table 1: PICs Supported by the M40e Router *(continued)*

PIC Family and Type	Ports	Model Number	Connectors	First Junos OS Release Support
"Channelized OC3/STM1 Circuit Emulation PIC with SFP (M40e Router)" on page 52	4	PB-4CHOC3-CE-SFP	• Optical: LC/PC	9.3
Channelized IQ				
"Channelized DS3 IQ PIC (M40e Router)" on page 34	4	PB-4CHDS3-QPP	Coaxial • Standard DS3 BNC coaxial cable interfaces	5.6
"Channelized E1 IQ PIC (M40e Router)" on page 40	10	PB-10CHE1-RJ48-QPP-N	• 120-ohm RJ-48C	9.1R4 9.2R3 9.3R1
"Channelized OC3 IQ PIC (M40e Router)" on page 45	1	PB-1CHOC3-SMIR-QPP	• Optical: SC/PC	7.1
"Channelized STM1 IQ PIC (M40e Router)" on page 66	1	PB-1CHSTM1-SMIR-QPP	• Optical: SC/PC	5.7
"Channelized T1 IQ PIC (M40e Router)" on page 68	10	PB-10CHT1-RJ48-QPP	• 120-ohm RJ-48C connector (female)	7.4
Channelized Enhanced IQ (IQE)				
"Channelized DS3/E3 Enhanced IQ (IQE) PIC (M40e Router)" on page 36	4	PB-4CHDS3-E3-IQE-BNC	Coaxial • Standard DS3 BNC coaxial cable interfaces	9.3
"Channelized E1/T1 Enhanced IQ (IQE) PIC (M40e Router)" on page 42	10	PB-10CHE1-T1-IQE-RJ48	• 120-ohm RJ-48C connector (female)	9.5
"Channelized OC3/STM1 Enhanced IQ (IQE) PIC with SFP (M40e Router)" on page 47	2	PB-2CHOC3-STM1-IQE-SFP	• Optical: LC/PC	9.3
"Channelized OC12/STM4 Enhanced IQ (IQE) PIC with SFP (M40e Router)" on page 57				
• Channelized OC12/STM4 Enhanced IQ (IQE) PIC with SFP	1	PB-1CHOC12-STM4-IQE-SFP	• Optical: LC/PC	9.3
• Channelized OC12/STM4 Enhanced IQ (IQE) PIC with SFP	4	PB-4CHOC12-STM4-IQE-SFP	• Optical: LC/PC	9.4

Table 1: PICs Supported by the M40e Router *(continued)*

PIC Family and Type	Ports	Model Number	Connectors	First Junos OS Release Support
"Channelized OC48/STM16 Enhanced IQ (IQE) PIC with SFP (M40e Router)" on page 62	1	PB-1CHOC48-STM16-IQE-SFP	• Optical: LC/PC	9.4
DS3, E1, and T1				
"DS3/E3 Enhanced IQ (IQE) PIC (M40e Router)" on page 71	4	PB-4DS3-E3-IQE-BNC	• Standard DS3 BNC coaxial cable interfaces	9.3R2
"E1 PICs (M40e Router)" on page 74	4	PB-4E1-COAX PB-4E1-RJ48	• Four RJ-48 connectors (one per port) • Four coaxial connectors Custom 10-ft (3.05-m) posilock to BNC male cable, separate Rx and Tx	5.2
"T1 PIC (M40e Router)" on page 121	4	PB-4T1-RJ48	• 100-ohm RJ-48 connector	5.2
E1/T1 Circuit Emulation PIC				
"E1/T1 Circuit Emulation PIC (M40e Router)" on page 76	12	PB-12T1E1-CE-TELCO	• RJ-21 connector • Cables are rated for intra-building connections only.	9.3
E3 IQ				
"E3 IQ PIC (M40e Router)" on page 80	4	PB-4E3-QPP	Coaxial • Standard DS3 BNC coaxial cable interfaces	6.1
Ethernet				
"Fast Ethernet PICs (M40e Router)" on page 87				
• Fast Ethernet PIC	4	PB-4FE-TX	• RJ-45 • Two-pair, Category 5 unshielded twisted-pair • Pinout: MDI noncrossover	5.2
• Fast Ethernet PIC	8	PB-8FE-FX	• MT-RJ female	5.2

Table 1: PICs Supported by the M40e Router *(continued)*

PIC Family and Type	Ports	Model Number	Connectors	First Junos OS Release Support
• Fast Ethernet PIC	12	PB-12FE-TX-MDI PB-12FE-TX-MDIX	• One very high density connector interface (VHDCI) to RJ-21 cable that connects to an RJ-45 patch panel	5.4
• Fast Ethernet PIC	48	PB-48FE-TX	• Four VHDCI connectors VHDCI-to-RJ-21 cables that connect to an RJ-45 patch panel	5.2
"Gigabit Ethernet PICs with SFP (M40e Router)" on page 90				

• Gigabit Ethernet PIC with SFP	1	PB-1GE-SFP	• Optical: LC/PC
			• Copper: RJ-45
			  • Four-pair, Category 5 shielded twisted-pair connectivity
			  • Pinout: MDI crossover
				6.3

• Gigabit Ethernet PIC with SFP	2	PB-2GE-SFP	• Optical: LC/PC • Copper: RJ-45 • Four-pair, Category 5 shielded twisted-pair connectivity	6.4
• Gigabit Ethernet PIC with SFP	4	PB-4GE-SFP	• Optical: LC/PC • Copper: RJ-45 • Four-pair, Category 5 shielded twisted-pair connectivity	7.0
Gigabit Ethernet IQ				
"Gigabit Ethernet IQ PICs with SFP (M40e Router)" on page 93				

Table 1: PICs Supported by the M40e Router *(continued)*

PIC Family and Type	Ports	Model Number	Connectors	First Junos OS Release Support

• Gigabit Ethernet IQ PIC with SFP	1	PB-1GE-SFP-QPP	• Optical: LC/PC
			• Copper: RJ-45
			  • Four-pair, Category 5 shielded twisted-pair connectivity
			  • Pinout: MDI crossover
				6.0

• Gigabit Ethernet IQ PIC with SFP	2	PB-2GE-SFP-QPP	• Optical: LC/PC • Copper: RJ-45 • Four-pair, Category 5 shielded twisted-pair connectivity	6.1
Ethernet IQ2				
"Gigabit Ethernet IQ2 PICs with SFP (M40e Router)" on page 95				
• Gigabit Ethernet IQ2 PIC with SFP	4	PB-4GE-TYPE1-SFP-IQ2	• Optical: LC/PC • Copper: RJ-45 • Four-pair, Category 5 shielded twisted-pair connectivity	7.6R3
• Gigabit Ethernet IQ2 PIC with SFP	8	PB-8GE-TYPE2-SFP-IQ2	• Optical: LC/PC • Copper: RJ-45 • Four-pair, Category 5 shielded twisted-pair connectivity	7.6R2
Ethernet Enhanced IQ2 (IQ2E)				
"Gigabit Ethernet Enhanced IQ2 (IQ2E) PICs with SFP (M40e Router)" on page 98				

Table 1: PICs Supported by the M40e Router *(continued)*

PIC Family and Type	Ports	Model Number	Connectors	First Junos OS Release Support
• Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with SFP	4	PB-4GE-TYPE1-SFP-IQ2E	• Optical: LC/PC • Copper: RJ-45 • Four-pair, Category 5 shielded twisted-pair connectivity	9.4
• Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with SFP	8	PB-8GE-TYPE2-SFP-IQ2E	• Optical: LC/PC • Copper: RJ-45 • Four-pair, Category 5 shielded twisted-pair connectivity	9.4
Services				
"Adaptive Services II FIPS PIC (M40e Router)" on page 19	0	PB-AS2-FIPS	• None	7.5
"ES PIC (M40e Router)" on page 85	0	PB-ES-800	• None	5.2
"Monitoring Services II PIC (M40e Router)" on page 101	0	PB-PM2	• None	6.0
"Multiservices PICs (M40e Router)" on page 103				
• Multiservices 100 PIC	0	PB-MS-100-1	• None	8.1
• Multiservices 400 PIC	0	PB-MS-400-2	• None	8.1R2
"Tunnel Services PIC (M40e Router)" on page 123				
• Type 1 Tunnel Services PIC	0	PB-TUNNEL-1	• None	7.0
• Type 2 Tunnel Services PIC	0	PB-TUNNEL	• None	7.0
Serial				

Table 1: PICs Supported by the M40e Router *(continued)*

PIC Family and Type	Ports	Model Number	Connectors	First Junos OS Release Support
"EIA-530 PIC (M40e Router)" on page 82	2	PB-2EIA530	• Two DB-25 male connectors (one per port, included with PIC) • V.35 requires an EIA-530 to V.35 cable and connects to a V.35 DTE 34-pin Winchester type male cable (one per port) • X.21 requires an EIA-530 to X.21 cable and connects to a X.21 DTE DB-15 male cable	5.6
SONET/SDH				
"SONET/SDH OC3/STM1 Enhanced IQ (IQE) PIC with SFP (M40e Router)" on page 106	4	PB-4OC3-STM1-IQE-SFP	• Optical: LC/PC	9.3R2
"SONET/SDH OC3/STM1 (Multi-Rate) PICs with SFP (M40e Router)" on page 109				
• SONET/SDH OC3/STM1 (Multi-Rate) PIC with SFP	4	PB-4OC3-1OC12-SON-SFP	• Optical: LC/PC	8.4
• SONET/SDH OC3/STM1 (Multi-Rate) PIC with SFP	4	PB-4OC3-1OC12-SON-SFP	• Optical: LC/PC	8.3
"SONET/SDH OC12/STM4 Enhanced IQ (IQE) PIC with SFP (M40e Router)" on page 112	1	PB-1OC12-STM4-IQE-SFP	• Optical: LC/PC	9.3
"SONET/SDH OC12/STM4 (Multi-Rate) PICs with SFP (M40e Router)" on page 115				
• SONET/SDH OC12/STM4 (Multi-Rate) PIC with SFP	1	PB-1OC12-SON-SFP	• Optical: LC/PC	8.4
• SONET/SDH OC12/STM4 (Multi-Rate) PIC with SFP	4	PB-1OC12-SON-SFP	• Optical: LC/PC	8.3
"SONET/SDH OC48/STM16 (Multi-Rate) PIC with SFP (M40e Router)" on page 118	1	PB-1OC48-SON-B-SFP	• Optical: LC/PC	8.3

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5

FPCs Supported (M40e Router)

The M40e router supports the FPCs listed in Table 2 on page 14. Inserting a combination of PICs with an aggregate higher than the maximum throughput per FPC is supported but constitutes oversubscription of the FPC.

Table 2: FPCs Supported by the M40e Router

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

Related Documentation

- M40e PICs Description on page 3
- PIC/FPC Compatibility (M40e Router) on page 15

PIC Combination Limitations (M40e Router)

In most cases, you can install PICs of different media types on the same FPC as long as the FPC and the router support those PICs. However, configuration rules might limit certain combinations of PICs on some platforms. If you have different PIC families on a single FPC, review the configuration rules to plan which PICs to install on the FPCs for your router. Consult the most recent technical bulletins about configuration rules for PIC combination limitations on the Juniper Networks Support site at http://www.juniper.net/support/. Newer Junos OS services for some PICs can require significant Internet Processor ASIC memory. Ethernet and SONET PICs typically do not use large amounts of memory. Gigabit Ethernet, ATM2, IQ serial PICs, and Multiservices PICs use more. To conserve memory, you can group PICs in the same family together on the same FPC.

When you upgrade to Junos OS Release 7.5 or later, a warning appears if any configuration rules affect your PIC combinations. If you continue the installation, one or more PICs might appear to be online (the LEDs are on), but the Junos OS cannot enable them and they cannot pass traffic. As a workaround, you can:

- Install a Junos OS release that supports the combination.
- Install PICs on a different FPC.
- Remove PICs from the affected FPC.

Related Documentation

- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6
- FPCs Supported (M40e Router) on page 14

PIC/FPC Compatibility (M40e Router)

Table 3 on page 15 provides a PIC/FPC compatibility matrix for the current PICs supported by the M40e router. The table lists the first Junos OS Release in which the FPC supports the PIC. For example, Junos OS Release 7.2 is the first release in which the M40e-FPC1-EP supports the ATM2 OC3/STM1 IQ, 2-port PIC.

NOTE: A – indicates that the PIC is not supported by the FPC.

Table 3: M40e PIC/FPC Compatibility

PIC Type	M40e-FPC	M40e-FPC1-EP	M40e-FPC2-EP
ATM2 IQ PICs			
ATM2 IQ DS3, 4-port	6.1	7.2	–
ATM2 IQ E3, 4-port	6.1	7.2	–
ATM2 IQ OC3/STM1, 2-port	5.5	7.2	–
ATM2 OC12/ STM4 IQ, 1-port	5.5	7.2	–
ATM2 OC12/ STM4 IQ, 2-port	–	–	5.5
ATM2 OC48/ STM16 IQ, 1-port SFP	–	–	7.3
Channelized PICs			
ChOC3/STM1 Circuit Emulation with SFP, 4-port	9.3	9.3	–
ChOC12, 1-port	5.2	7.2	–
Channelized IQ PICs			
ChDS3 IQ, 4-port	5.6	7.2	–
ChE1 IQ, 10-port PB-10CHE1-RJ48-QPP-N	9.1R4 9.2R3 9.3R1	9.1R4 9.2R3 9.3R1	–
ChOC3 IQ, 1-port	7.1	7.2	–
ChSTM1 IQ, 1-port	5.7	7.2	–
ChT1 IQ, 10-port	7.4	7.4	–

Table 3: M40e PIC/FPC Compatibility *(continued)*

PIC Type	M40e-FPC	M40e-FPC1-EP	M40e-FPC2-EP
Channelized Enhanced IQ (IQE) PICs			
ChDS3/E3 IQE, 4-port NOTE: Only DS3 is channelized.	–	9.3	–
ChE1/T1 IQE, 10-port	–	9.5	–
ChOC3/STM1 IQE, 2-port SFP	–	9.3	–
ChOC12/STM4 IQE, 1-port SFP	–	9.3	–
ChOC12/STM4 IQE, 4-port SFP	–	–	9.4
ChOC48/STM16 IQE, 1-port SFP	–	–	9.4
T1, DS3, E1, E3 PICs			
DS3/E3 IQE, 4-port	–	9.3R2	–
E1, 4-port	5.2	7.2	–
T1, 4-port	5.2	7.2	–
E1/T1 Circuit Emulation, 12-port	9.3	9.3	–
E3 IQ PICs			
E3 IQ, 4-port	6.1	7.2	–
Ethernet PICs			
Fast Ethernet, 4-port	5.2	7.2	–
Fast Ethernet, 8-port	5.2	7.2	–
Fast Ethernet, 12-port	5.4	7.2	–
Fast Ethernet, 48-port	–	–	7.3
Gigabit Ethernet, 1-port SFP	6.3	7.2	–
Gigabit Ethernet, 2-port SFP	–	–	7.3
Gigabit Ethernet, 4-port SFP	–	–	7.3
Ethernet IQ PICs			
Gigabit Ethernet IQ, 1-port SFP	6.0	7.2	–
Gigabit Ethernet IQ, 2-port SFP	–	–	7.3

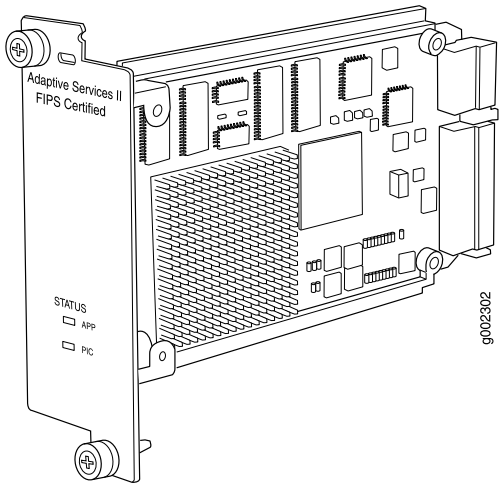
Table 3: M40e PIC/FPC Compatibility *(continued)*

PIC Type	M40e-FPC	M40e-FPC1-EP	M40e-FPC2-EP
Ethernet IQ2 PICs			
Gigabit Ethernet IQ2, 4-port SFP	–	7.6R3	–
Gigabit Ethernet IQ2, 8-port SFP	–	–	7.6R2
Ethernet Enhanced IQ2 (IQ2E) PICs			
Gigabit Ethernet Enhanced IQ2 (IQ2E), 4-port SFP	–	9.4	–
Gigabit Ethernet Enhanced IQ2 (IQ2E), 8-port SFP	–	–	9.4
Service PICs			
Adaptive Services II (AS) FIPs	7.5	7.5	–
Adaptive Services II (AS) Layer 2 Services	7.5	7.5	–
ES	5.2	7.2	–
Link Services	5.2	7.2	–
Monitoring Services II	6.0	7.2	–
Multiservices 100	–	8.1	–
Multiservices 400	–	–	8.1R2
Tunnel Services (Type 1)	7.0	7.2	7.3
Tunnel Services (Type 2)	7.0	7.2	7.3
Serial PIC			
EIA-530	5.6	7.2	–
SONET/SDH PICs			
OC3/STM1 IQE, 4-port SFP	–	9.3R2	–
OC3/STM1 (Multi-Rate), 4-port SFP	–	8.4	8.3
OC12/STM4 IQE, 1-port SFP	–	9.3	–
OC12/STM4 (Multi-Rate), 1-port SFP	–	8.4	–
OC12/STM4 (Multi-Rate), 4-port SFP	–	–	8.3
OC48/STM16 (Multi-Rate), 1-port SFP	–	–	8.3

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- PIC Combination Limitations (M40e Router) on page 14
- M40e PICs Supported on page 6

Adaptive Services II FIPS PIC (M40e Router)



Software release	• Junos OS Release 8.0R2 and later (Type 1) For information on which FPCs support this PIC, see "PIC/FPC Compatibility (M40e Router)" on page 15. NOTE: This PIC is not supported in Junos OS Release 8.1R1.
Description	• Junos-FIPS requires an Adaptive Services II FIPS PIC for external IPSec connections. See the *Secure Configuration Guide for Common Criteria and Junos-FIPS* for more information. • Tunnel services is included with the PIC and does not require an individual license. • Individual licenses must be purchased for additional services such as Network Address Translation (NAT), stateful firewall, intrusion detection services (IDS), IPSec. J-Flow accounting, and voice services. For information about which services are supported by PIC and platform type, see the *Junos OS Services Interfaces Configuration Guide*. • Power requirement: 0.4 A @ 48 V (19 W)
Hardware features	• Support for up to 2000 service sets • Active monitoring on up to 1 million flows • Support for MTUs up to 9192 bytes for Gigabit Ethernet and SONET interfaces

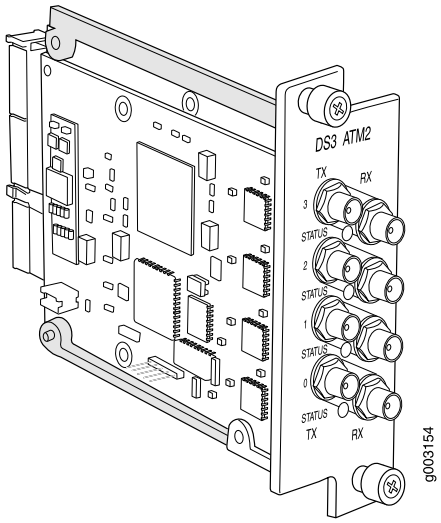
Software features	For a list of the software features available for services PICs, see the *Junos OS Services Interfaces Configuration Guide*.
	
	Depending on your Junos OS Release and individual licenses, software features for this PIC can include:
	
	• Stateful firewall with packet inspection:
	  • Detects SYN attacks, ICMP and UDP floods, and ping-of-death attacks
	• NAT for IP addresses
	• Port Address Translation (PAT) for port numbers
	• J-Flow accounting exports cflowd version 5 and version 8 records
	• Tunnel services:
	  • IP-IP unicast tunneling
	  • GRE unicast tunneling—Supports GRE fragmentation
	  • PIM sparse mode unicast tunneling
	  • Virtual tunnel interface for Layer 3 VPNs
	• IPSec encryption
	• Voice services:
	  • Compressed Real-Time Protocol (CRTP)
	• Encapsulations:
	  • Multilink Frame Relay (MLFR)
	  • Multilink Point-to-Point Protocol (MLPP)

LEDs	Status LED, one tricolor: • Off—PIC is offline and it is safe to remove it from the chassis. • Green—PIC is operating normally. • Yellow—PIC is initializing. • Red—PIC has an error or failure and no further harm can be done by removing it from the chassis. Application LED, one tricolor: • Off—Service is not running. • Green—Service is running under acceptable load. • Yellow—Service is overloaded.

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

ATM2 DS3 IQ PIC (M40e Router)



Software release	• Junos OS Release 6.1 and later For information on which FPCs support this PIC, see “PIC/FPC Compatibility (M40e Router)” on page 15.
Description	• Four DS3 ports • Power requirement: 0.41 A @ 48 V (20.0 W) • Fine-grained queuing per logical interface • ATM standards compliant

Hardware features	• 16-MB SDRAM memory for ATM segmentation and reassembly (SAR)
	• ATM switch ID
	• Configurable framing options:
	  ◦ C-bit with ATM direct mapping
	  ◦ C-bit with Physical Layer Convergence Protocol (PLCP) framing (default)
	  ◦ M23 ATM direct mapping
	  ◦ M23 with PLCP framing
	• Internal and loop timing

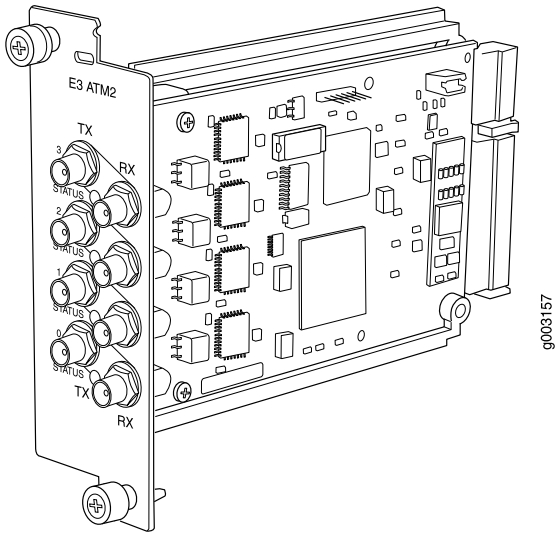
Software features	• Per-virtual circuit (VC) and per-virtual path (VP) traffic shaping
	• Unspecified bit rate (UBR) traffic shaping
	• Fine-grained variable bit rate (VBR) traffic shaping
	• Circuit cross-connect (CCC)
	• ATM Inverse Address Resolution Protocol (ARP), which enables routers to automatically learn the IP address of the router on the far end of an ATM permanent virtual circuit (PVC)
	• Simple Network Management Protocol (SNMP):
	  ◦ Management Information Base (MIB) 2 (RFC 1213)
	  ◦ ATM MIB (RFC 1695)
	  ◦ SONET MIB
	• AAL5 encapsulations:
	  ◦ ATM-VC-MUX
	  ◦ ATM-NLPID
	  ◦ ATM-Cisco-LLPID
	  ◦ ATM-SNAP
	  ◦ ATM-CCC-VC-MUX

Cables and connectors	• 10 ft (3.05 m) posilock SMB to BNC (provided) • Four pairs of Rx and Tx coaxial cables
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	• Alarm indication signal (AIS) • Far-end block error (FEBE) • Frame error • Idle code • Idle received • Local and remote loopback • Loss of signal (LOS) • Out of frame (OOF) • Path parity error • Yellow alarm

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

ATM2 E3 IQ PIC (M40e Router)



Software release	• Junos OS Release 6.1 and later For information on which FPCs support this PIC, see “PIC/FPC Compatibility (M40e Router)” on page 15.
Description	• Four E3 ports • Power requirement: 0.41 A @ 48 V (20 W) • Fine-grained queuing per logical interface • ATM standards compliant

Hardware features	• 16-MB SDRAM memory for ATM segmentation and reassembly (SAR)
	• ATM switch ID
	• Configurable framing options:
	  ◦ G.751 direct mapping
	  ◦ G.751 with PLCP encapsulation (default)
	  ◦ G.832 ATM direct mapping
	• Internal and loop timing

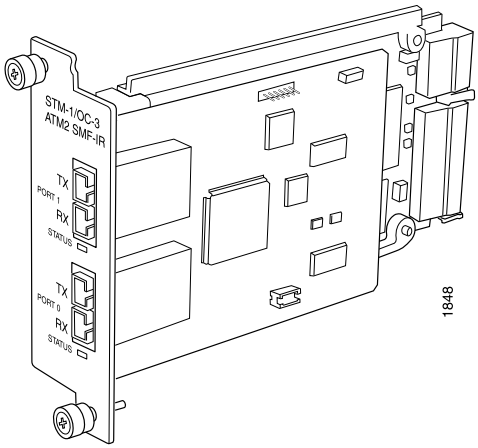
Software features	• Per-virtual circuit (VC) and per-virtual path (VP) traffic shaping
	• Unspecified bit rate (UBR) traffic shaping
	• Fine-grained variable bit rate (VBR) traffic shaping
	• Circuit cross-connect (CCC)
	• ATM Inverse Address Resolution Protocol (ARP), which enables routers to automatically learn the IP address of the router on the far end of an ATM permanent virtual circuit (PVC)
	• Simple Network Management Protocol (SNMP):
	  • Management Information Base (MIB) 2 (RFC 1213)
	  • ATM MIB (RFC 1695)
	  • SONET MIB
	• AAL5 encapsulations:
	  • ATM-VC-MUX
	  • ATM-NLPID
	  • ATM-Cisco-LLPID
	  • ATM-SNAP
	  • ATM-CCC-VC-MUX

Cables and connectors	• 10 ft (3.05 m) posilock SMB to BNC (provided) • Four pairs of Rx and Tx coaxial cables
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	• Alarm indication signal (AIS) • Frame error • Line code violation • Local and remote loopback • Loss of signal (LOS) • Out of frame (OOF) • Yellow alarm

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

ATM2 OC3/STM1 IQ PIC (M40e Router)



Software release	• Junos OS Release 5.5 and later For information on which FPCs support this PIC, see “PIC/FPC Compatibility (M40e Router)” on page 15.
Description	• Two OC3 ports • Power requirement: 0.41 A @ 48 V (20 W) • Fine-grained queuing per logical interface • Conforms to ANSI T1.105-1991 and T1E1.2/93-020R1 • ATM and SONET/SDH standards compliant • Alarm and event counting and detection • Compatible with well-known ATM switches • ATM switch ID, which displays the switch IP address and local interface name of the adjacent Fore ATM switches
Hardware features	• Single 3010 SAR for segmentation and reassembly into 53 byte ATM cells • High-performance parsing of SONET/SDH frames • ASIC-based packet segmentation and reassembly (SAR) management and output port queuing • 64 MB SDRAM memory for ATM SAR • Packet buffering, Layer 2 parsing

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
	• ATM Inverse Address Resolution Protocol (ARP), which enables routers to automatically learn the IP address of the router on the far end of an ATM permanent virtual circuit (PVC)
	• Simple Network Management Protocol (SNMP):
	  ◦ Management Information Base (MIB) 2 (RFC 1213)
	  ◦ ATM MIB (RFC 1695)
	  ◦ SONET MIB
	• 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 SC/PC connector (RX and TX)
	• SONET/SDH OC3/STM1 fixed transceivers:
	  ◦ Intermediate Reach
	  ◦ Multimode
	Optical interface support—See SONET/SDH OC3/STM1 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	• 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)

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

ATM2 OC12/STM4 IQ PICs (M40e Router)

Figure 1: 1-Port ATM2 OC12/STM4 IQ PIC

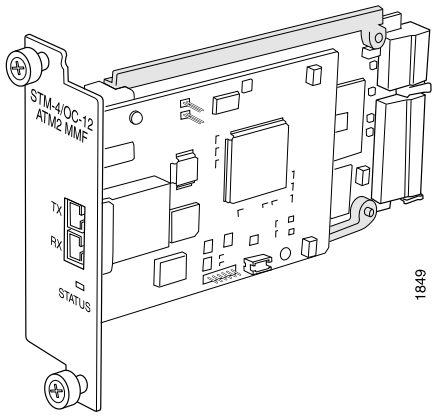
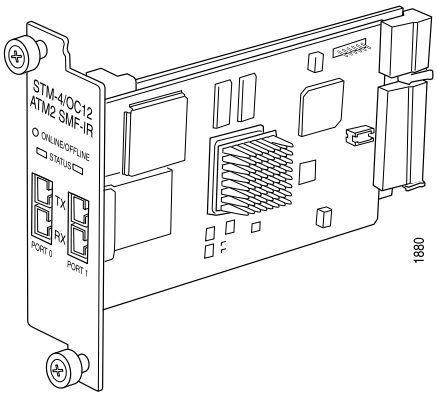


Figure 2: 2-Port ATM2 OC12/STM4 IQ PIC



Software release	• Junos OS Release 5.5 and later For information on which FPCs support these PICs, see "PIC/FPC Compatibility (M40e Router)" on page 15.

Description	• One or two OC12 ports
	• Power requirement:
	  • 1-port: 0.41 A @ 48 V (20 W)
	  • 2-port: 0.52 A @ 48 V (25 W)
	• Fine-grained queuing per logical interface
	• Conforms to ANSI T1.105-1991 and T1E1.2/93-020R1
	• Complies with ATM and SONET/SDH standards
	• Alarm and event counting and detection
	• Compatible with well-known ATM switches
	• ATM switch ID, which displays the switch IP address and local interface name of the adjacent Fore ATM switches

Hardware features	• ATM2 IQ 1-port OC12 PICs have one 3010 SAR for segmentation and reassembly into 53-byte ATM cells; ATM2 IQ 2-port OC12 PICs have dual 3010 SAR • High-performance parsing of SONET/SDH frames • ASIC-based packet segmentation and reassembly (SAR) management and output port queuing • 64 MB SDRAM memory for ATM SAR • Packet buffering, Layer 2 parsing

Software features	• Circuit cross-connect 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), and loop cells
	• Point-to-point and point-to-multipoint mode Layer 2 counters per VC and per VP
	• Local and remote loopback
	• ATM Inverse ARP, which enables routers to automatically learn the IP address of the router on the far end of an ATM PVC
	• Simple Network Management Protocol (SNMP):
	  ◦ Management Information Base (MIB) 2 (RFC 1213)
	  ◦ ATM MIB (RFC 1695)
	  ◦ SONET MIB
	• 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 SC/PC connector (Rx and Tx)
	• SONET/SDH OC12/STM4 fixed transceivers:
	  ◦ Intermediate Reach
	  ◦ Multimode
	Optical interface support—See SONET/SDH OC12/STM4 Optical Interface Specifications

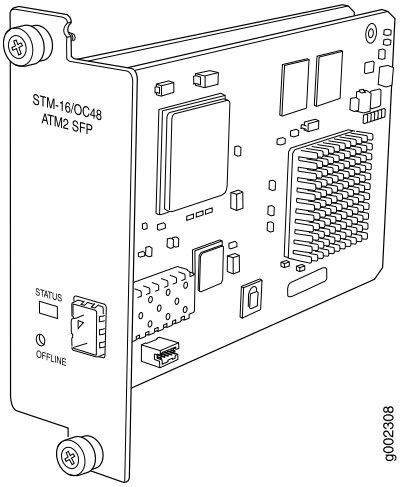
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events	• 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)

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

ATM2 OC48/STM16 IQ PIC with SFP (M40e Router)



Software release	• Junos OS Release 7.3 and later For information on which FPCs support this PIC, see “PIC/FPC Compatibility (M40e Router)” on page 15.
Description	• One OC48 port • Power requirement: 0.41 A @ 48 V (20 W) • Fine-grained queuing per logical interface • Conforms to ANSI T1.105-1991 and T1E1.2/93-020R1 • Complies with ATM and SONET/SDH standards • Alarm and event counting and detection • Compatible with well-known ATM switches • ATM switch ID, which displays the switch IP address and local interface name of the adjacent Fore ATM switches
Hardware features	• ATM2 IQ 1-port OC48 PICs have one 3010 SAR for segmentation and reassembly into 53-byte ATM cells. • High-performance parsing of SONET/SDH frames • ASIC-based packet segmentation and reassembly (SAR) management and output port queuing • 64-MB SDRAM memory for ATM SAR • Packet buffering, Layer 2 parsing

Software features	• Multiprotocol Label Switching (MPLS) circuit cross-connect 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), and loop cells
	• Point-to-point and point-to-multipoint mode Layer 2 counters per VC and per VP
	• Local and remote loopback
	• ATM Inverse ARP, which enables routers to automatically learn the IP address of the router on the far end of an ATM PVC
	• Simple Network Management Protocol (SNMP):
	  ◦ Management Information Base (MIB) 2 (RFC 1213)
	  ◦ ATM MIB (RFC 1695)
	  ◦ SONET MIB
	• 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

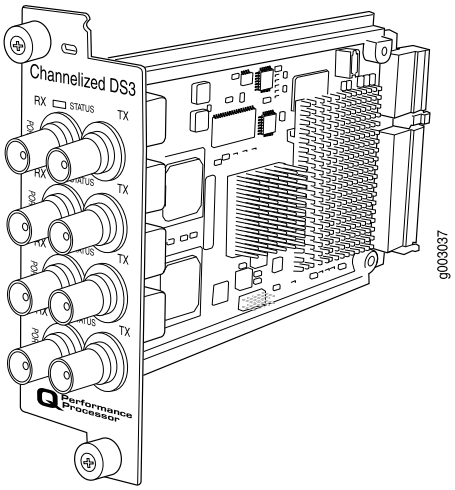
Cables and connectors	• Duplex LC/PC connector (RX and TX) • SONET/SDH OC48/STM16 SFPs: ◦ Intermediate Reach (model number: SFP-10C48-IR) Optical interface support—See SONET/SDH OC48/STM16 Optical Interface Specifications
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events	• 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)

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

Channelized DS3 IQ PIC (M40e Router)



Software release	• Junos OS Release 5.6 and later For information on which FPCs support this PIC, see “PIC/FPC Compatibility (M40e Router)” on page 15.
Description	• Four DS3 ports • Power requirement: 0.32 A @ 48 V (15.6 W) • Fine-grained queuing per logical interface • Channelization: DS3, DS0

Hardware features	• Data service unit (DSU) functionality
	• Subrate and scrambling:
	  ◦ Digital Link/Quick Eagle
	  ◦ Kentrox
	  ◦ Larscom
	  ◦ ADTRAN
	  ◦ Verilink
	• B3ZS line encoding
	• M13 or C-bit parity
	• Full bit error rate test (BERT)
	• Local and remote loopback testing

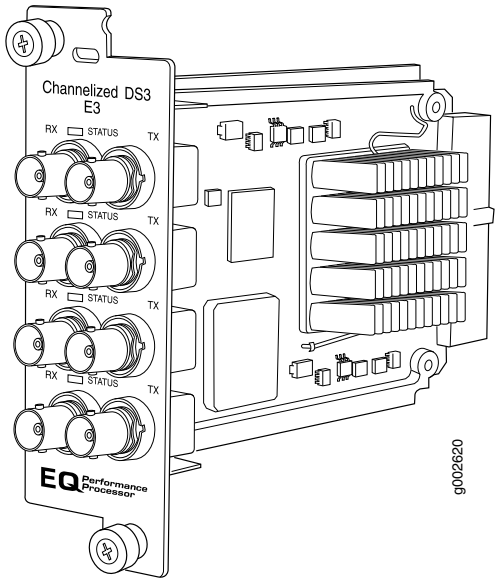
Software features	• Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)
	• Simple Network Management Protocol (SNMP): DS1 MIB, DS3 MIB
	• Dynamic, arbitrary channel configuration
	• Encapsulations:
	  ◦ Circuit cross-connect (CCC)
	  ◦ Translational cross-connect (TCC)
	  ◦ Frame Relay
	  ◦ High-Level Data Link Control (HDLC)
	  ◦ Point-to-Point Protocol (PPP)

Cables and connectors	• Standard DS3 BNC coaxial cable interfaces
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	• Alarm indication signal (AIS) • Excessive zeros (EXZ) • Far-end block error (FEBE) • Frame error • Idle code, Idle received • Line code violation (LCV) • Loss of signal (LOS) • Out of frame (OOF) • Parity bit (P-bit) disagreements • Path parity error • Yellow alarm bit (X-bit) disagreements
Instrumentation (counters)	• Layer 2 per-queue and per-channel packet and byte counters

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

Channelized DS3/E3 Enhanced IQ (IQE) PIC (M40e Router)



Software release	• Junos OS Release 9.3 and later (Type 1) For information on which FPCs support this PIC, see “PIC/FPC Compatibility (M40e Router)” on page 15.

Description	• Four E3 or Channelized DS3 ports
	• E3 or Channelized DS3 is configurable on a per-port granularity
	• DS3 channelization:
	  ◦ 4 DS3 channels
	  ◦ 112 DS1 channels
	  ◦ 1011 DS0 channels
	• Power requirement: 0.53 A @ 48 V (25.4 W)

Hardware features	• Ports are numbered 0 through 3 top to bottom

Software features

- Maximum transmission units (MTUs) of up to 9000 bytes
- Dynamic, arbitrary channel configuration
- Subrate and scrambling:

NOTE: Only DS3 supports subrate and scrambling.

  - Digital Link/Quick Eagle
  - Kentrox
  - Larscom
  - ADTRAN
  - Verilink (subrate: only port A mode)

NOTE: For DS3 interfaces, Verilink does not function if an IQE interface is paired with an IQ interface.

- Data service unit (DSU) functionality
- B3ZS line encoding
- Framing: M13, C-bit parity, framed clear channel
- Full bit error rate test (BERT) for DS0, DS1, and DS3
- ANSI T1.403 FDL
- Internal and loop clocking for DS3 and DS1
- DS3 far end alarm and control (FEAC) channel
- Local line, remote line, and remote playback loopback testing for each DS3 and DS1channels
- 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.
- Simple Network Management Protocol (SNMP): DS1 MIB, DS3 MIB
- • 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

Cables and connectors

- Standard DS3 BNC coaxial cable interfaces

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

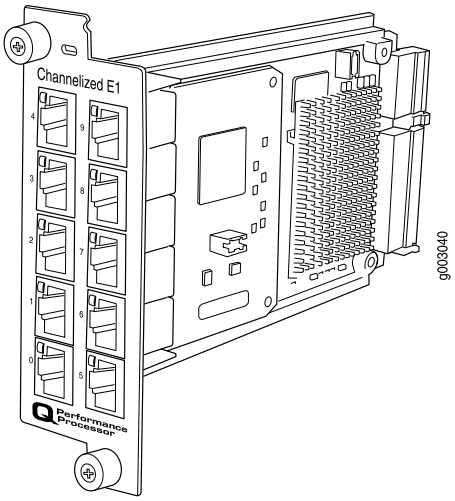
Alarms, errors, and events	• Alarm reporting for error statistics and failure counts
	• DS1 alarms:
	  • Alarm indication signal (AIS)
	  • Loss of frame (LOF)
	  • Remote alarm indication signal (RAIS)
	• DS1 error detection:
	  • Bursty errored seconds (BES)
	  • CRC errors
	  • Errored seconds (ES)
	  • Line errored seconds (LES)
	  • Loss of framing seconds (LOFS)
	  • Loss of signal seconds (LOS)
	  • Severely errored seconds (SES)
	  • Severely errored framing seconds (SEFS)
	  • Unavailable seconds (UAS)
	• DS3 alarms:
	  • Alarm indication signal (AIS)
	  • Loss of frame (LOF)
	  • Loss of signal (LOS)
	  • Phase lock loop (PLL)
	• 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

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

Channelized E1 IQ PIC (M40e Router)



Software release	• PB-10CHE1-RJ48-QPP-N: Junos OS Release 9.1R4, 9.2R3, 9.3R1 and later For information on which FPCs support this PIC, see "PIC/FPC Compatibility (M40e Router)" on page 15.
Description	• Ten E1 ports • Power requirement: 0.15 A @ 48 V (7.2 W) • Fine-grained queuing per logical interface • Channelization: E1, DS0
Hardware features	• Data service unit (DSU) functionality • Ports configurable as clear channel E1 interfaces with 2.048-Mbps connectivity • Supports unframed E1 G.703 and G.704 framing modes • Supports HDB3 line coding • CRC4 configurable • Local and remote loopback testing

Software features	• Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)
	• Simple Network Management Protocol (SNMP): E1 MIB, DS0 MIB
	• Dynamic, arbitrary channel configuration
	• Full bit error rate test (BERT)
	• Encapsulations:
	  ◦ Circuit cross-connect (CCC)
	  ◦ Translational cross-connect (TCC)
	  ◦ Frame Relay
	  ◦ High-Level Data Link Control (HDLC)
	  ◦ Point-to-Point Protocol (PPP)

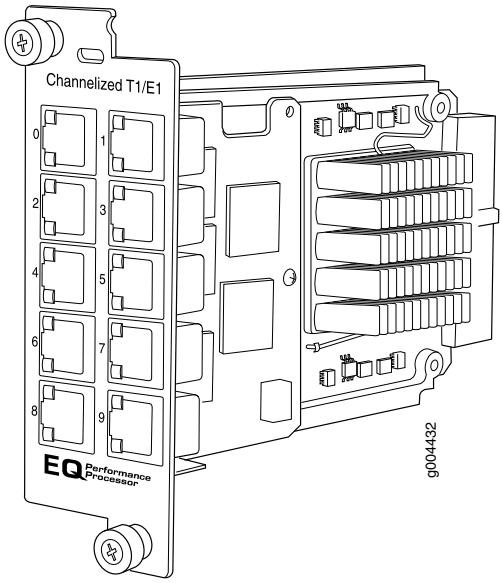
Cables and connectors	• 120-ohm RJ-48C

LEDs	One bicolor per E1 port: • Off—Port not enabled • Green—Physical E1 link is up; individual subchannels can be down • Red—Physical E1 link is down
Alarms, errors, and events	• Alarm indication signal (AIS) • Loss of frame (LOF) • Out of frame (OOF) • Failed signal rate (FSR)
Instrumentation (counters)	• Layer 2 per-queue and per-channel packet and byte counters

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

Channelized E1/T1 Enhanced IQ (IQE) PIC (M40e Router)



Software release	• Junos OS Release 9.5 and later (Type 1) For information on which FPCs support this PIC, see “PIC/FPC Compatibility (M40e Router)” on page 15.

Description	• Ten E1 or T1 ports
	• DS1 and E1 interfaces are selectable on a per-port granularity
	• E1 channelization per PIC:
	  • 10 E1 channels
	  • 310 DS0 channels
	• T1 channelization per PIC:
	  • 10 T1 channels
	  • 240 DS0 channels
	• Power requirement: 0.52 A @ 48 V (24.73 W)

Hardware features	Ports are numbered: • Top row: 0 and 1 from left to right • Second row: 2 and 3 from left to right • Third row: 3 and 4 from left to right • Bottom row: 5 and 6 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.
	• Support sending and receiving in-band loopback codes in both framed and unframed mode:
	  • Framed in-band loopback at CSU
	  • Framed in-band loopback at Smartjack (ANSI)

- Unframed in-band loopback at CSU
- Unframed in-band loopback at Smartjack (ANSI)

- You can configure the following framing modes using the CLI:
  - T1—SF (D4/superframe), ESF (extended superframe)
  - E1—G704, G704–no-crc4, unframed
- Packet buffering, Layer 2 parsing
- Local line, remote line, and remote payload loopback testing; each channel can be looped individually and independently of other channels (DS1/E1 channels)
- Simple Network Management Protocol (SNMP): T1 MIB (RFC 1406)
- Dynamic, arbitrary channel configuration
- Full bit error rate test (BERT)
- Clocking: internal and loop (clock recovered from network and use for transmit). Internal timing is the default for channelized T1 ports. The external master clock can be a multiple of 2.048 MHz or 1.544 MHz for E1 or T1 operation.
- Line coding:
  - T1—CLI configurable as AMI or B8ZS
  - E1—HDB3
- 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
  - Point-to-Point Protocol (PPP)
  - PPP for CCC
  - PPP for TCC
- Encapsulations available only for DS0 and DS1:
  - Multilink Frame Relay end-to-end (MLFR FRF.15)
  - Multilink Frame Relay (MLFR) UNI NNI (MFR FRF.16)
  - Multilink PPP (MLPPP)
- Encapsulations available only for DS1:
  - PPP over Frame Relay

Cables and connectors	• 120-ohm RJ-48C connector (female)

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

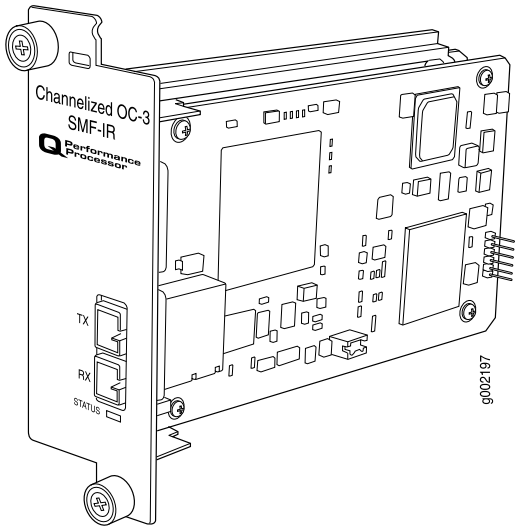
Alarms, errors, and events	• DS1 alarms:
	  • Alarm indication signal (AIS)
	  • Loss of frame (LOF)
	  • Remote alarm indication signal (RAIS)
	  • 24-hour alarm reporting history maintained for error statistics and failure counts, 15-minute intervals on all errors
	• DS1 error detection:
	  • Bursty errored seconds (BES)
	  • CRC errors
	  • Errored seconds (ES)
	  • Line errored seconds (LES)
	  • Loss of framing seconds (LOFS)
	  • Loss of signal seconds (LOSS)
	  • Severely errored seconds (SES)
	  • Severely errored framing seconds (SEFS)
	  • Unavailable seconds (UAS)

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

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

Channelized OC3 IQ PIC (M40e Router)



Software release	• Junos OS Release 7.1 and later For information on which FPCs support this PIC, see “PIC/FPC Compatibility (M40e Router)” on page 15.
Description	• One OC3 port • Power requirement: 0.39 A @ 48 V (18.6 W) • Fine-grained queuing per logical interface • Channelization: DS3, DS1, DS0

Hardware 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 and remote loopback testing

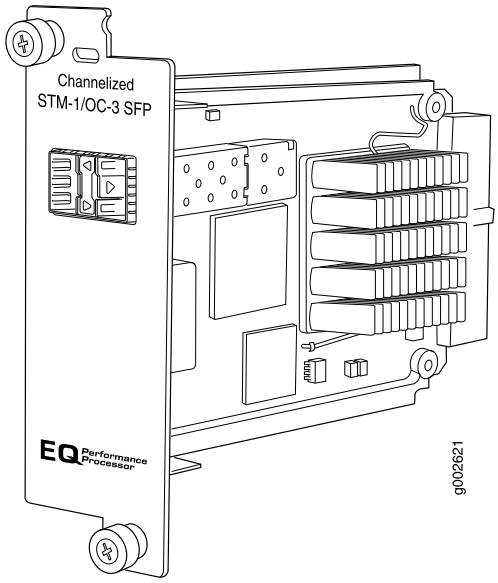
Software features	• Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)
	• Simple Network Management Protocol (SNMP): OC3 MIB, DS3 MIB, T1 MIB
	• Dynamic, arbitrary channel configuration
	• Full bit error rate test (BERT)
	• Encapsulations:
	  ◦ Circuit cross-connect (CCC)
	  ◦ Translational cross-connect (TCC)
	  ◦ Frame Relay
	  ◦ High-Level Data Link Control (HDLC)
	  ◦ Point-to-Point Protocol (PPP)

Cables and connectors	• Duplex SC/PC connector (Rx and Tx); single-mode fiber intermediate-reach fiber • SONET/SDH OC3/STM1 fixed transceivers: ◦ Intermediate Reach (IR-1) Optical interface support—See SONET/SDH OC3/STM1 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	• Alarm indication signal (AIS-L, AIS-P) • Bit error rate signal degrade (BERR-SD), bit error rate signal fail (BERR-SF) • Bit interleaved parity errors B1, B2, B3 • Errored seconds (ES-S, ES-L, ES-P), far-end bit errors REI-L, REI-P (CV-LFE, CV-PFE), Far-end block error (FEBE), 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) • Frame error • Idle code, Idle received • Loss of frame (LOF), loss of pointer (LOP-P), loss of signal (LOS) • Out of frame (OOF) • Payload mismatch (PLM-P), payload unequipped (UNEQ-P) • Parity bit (P-bit) disagreements • Path parity error • Remote defect indication (RDI-L, RDI-P) • 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) • Yellow alarm bit (X-bit) disagreements

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

Channelized OC3/STM1 Enhanced IQ (IQE) PIC with SFP (M40e Router)



Software release	• Junos OS Release 9.3 and later (Type 1) For information on which FPCs support this PIC, see "PIC/FPC Compatibility (M40e Router)" on page 15.

Description	• Two OC3 or STM1 ports
	• SONET or SDH is configurable on a per-port granularity
	• SONET channelization:
	  • 2 OC3 channels
	  • 6 DS3 channels
	  • 168 DS1 channels
	  • 1011 DS0 channels
	• SDH channelization:
	  • 2 STM1 channels (non-concatenated)
	  • 6 E3 channels
	  • 126 E1 channels
	  • 6 DS3 channels (Junos OS Release 10.1 and later)
	  • 168 DS1 channels (Junos OS Release 10.1 and later)
	  • 1011 DS0 channels
	• Power requirement: 0.56 A @ 48 V (27.1 W)

Hardware features	• Ports are numbered 0 and 1 from left to right

Software features

- Dynamic, arbitrary channel configuration
- 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
- 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	• Duplex LC/PC connector (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 support—See SONET/SDH OC3/STM1 Optical Interface Specifications

LEDs	One tricolor Status 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)
	  • Loss of clock (LOC)
	  • 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 clock (VLOC)
	  • 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 receiver error (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 clock (LOC)

- Loss of frame (LOF)
- Loss of light (LOL)
- Loss of signal (LOS)
- Multiplex section—alarm indication signal (MS-AIS)
- Multiplex section—far-end receive error (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 clock (TU-LOC)
- Tributary unit—loss of pointer (TU-LOP)
- Tributary unit—mismatch (TU-MIS)
- Tributary unit—remote defect indication (TU-RD1)
- Tributary unit—unequipped (TU-UNEQ)

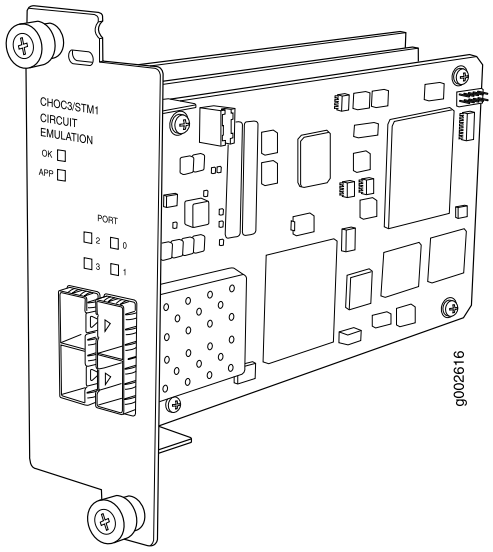
- DS1 alarms:
  - Alarm indication signal (AIS)
  - Loss of frame (LOF)
  - Remote alarm indication signal (RAIS)
- DS1 error detection:
  - Bursty errored seconds (BES)
  - CRC errors
  - Errored seconds (ES)
  - Line errored seconds (LES)
  - Loss of framing seconds (LOFS)
  - Loss of signal seconds (LOS)
  - Severely errored seconds (SES)
  - Severely errored framing seconds (SEFS)
  - Unavailable seconds (UAS)
- DS3 alarms:
  - Alarm indication signal (AIS)
  - Loss of frame (LOF)
  - Loss of signal (LOS)
  - Phase lock loop (PLL)
- 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)

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

Channelized OC3/STM1 Circuit Emulation PIC with SFP (M40e Router)



Software release	• Junos OS Release 9.3 and later For information on which FPCs support this PIC, see “PIC/FPC Compatibility (M40e Router)” on page 15.
Description	• Four OC3/STM1 ports • Power requirement: 0.52 A @ 48 V (25 W) • Channelization: DS1 Channelization down to E1/T1 Each port can be channelized as 84 T1 ports for a total of 336 T1 pseudowires or 63 E1 ports for a total of 252 pseudowires.
Hardware features	• Subrate and scrambling: ◦ Digital Link/Quick Eagle ◦ Kentrox ◦ Larscom ◦ ADTRAN ◦ Verilink • M13/C-bit parity encoding • Local and remote loopback testing

Software features	• Loop timing and external timing
	• Optical diagnostics
	• AM1 or B8ZS line encoding
	• APS/SDH MSP
	• Fractional mode and framed clear channel mode
	• Superframe (D4/SF) and extended superframe (ESP) framing
	• Simple Network Management Protocol (SNMP):
	  ◦ OC3 MIB
	  ◦ T1 MIB
	  ◦ ATM MIB (Junos OS Release 10.2 and later)
	• Automatic protection switching (APS)
	• Dynamic, arbitrary channel configuration
	• Full bit error rate test (BERT)
	• Encapsulations: Structure-agnostic time-division multiplexing (TDM) over packet (SAToP) (RFC 4553)
	• Pseudowire emulation edge-to-edge (PWE3) for ATM (RFC 4717) (Junos OS Release 9.6 and later)
	• ATM Pseudowire emulation edge-to-edge via dynamic labels (LDP, RSVP-TE) (Junos OS Release 9.6 and later)
	• Inverse mulitplexing (IMA) for ATM (Junos OS Release 10.0 and later)
	• ATM QoS for the Junos OS Release 10.2 and later:
	  ◦ Per-virtual circuit (VC) and per-virtual path (VP) traffic shaping
	  ◦ Unspecified bit rate (UBR) traffic shaping
	  ◦ Fine-grained real-time variable bit rate (rtVBR) and real-time variable bit rate (nrtVBR) traffic shaping
	  ◦ Port-level egress shaping
	  ◦ Constant bit rate (CBR)
	  ◦ Policing on a per virtual circuit basis
	  ◦ Independent peak cell rate (PCR) and sustained cell rate (SCR) policing
	  ◦ Counting, tagging, or discard policing actions

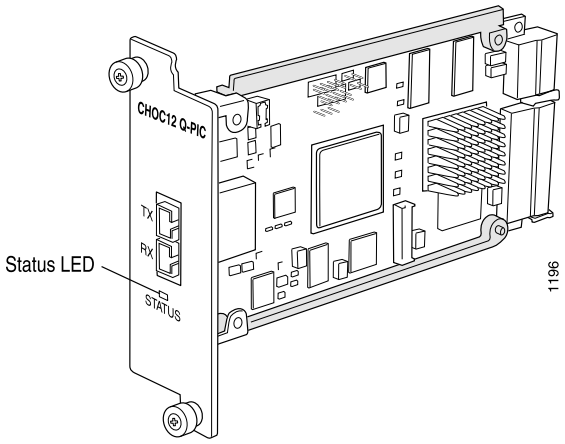
Cables and connectors	• Duplex LC/PC connector (Rx and Tx)
	• SONET/SDH OC3/STM1 SFPs:
	  ◦ Multimode (model number: SFP-OC3-SR)
	  ◦ Intermediate Reach (IR-1) (model number: SFP-OC3-IR)
	  ◦ Long reach (LR-1) (model number: SFP-OC3-LR)
	Optical interface support—See SONET/SDH OC3/STM1 Optical Interface Specifications

LEDs	OK LED, one tricolor: • Off—PIC is offline and it is safe to remove it from the router. • Green—PIC is operating normally. • Yellow—PIC is initializing. • Red—PIC has an error or failure. APP LED, one bicolor: • Off—Monitoring application is not running. • Green—Monitoring application is running under acceptable load. 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	Structure-agnostic alarms for T1 interface: • Alarm indication signal (AIS-L, AIS-P) • Loss of signal (LOS) • Errored seconds (ES) • Line-errored seconds (LES) • Severely errored seconds (SES) • Unavailable errored seconds (UAS) • Bipolar violation (BPV) • Controlled slip (CS) • Line code violation (LCV) Structure-agnostic alarms for E1 interface: • Alarm indication signal (AIS-L, AIS-P) • Loss of signal (LOS) • Errored seconds (ES) • Line-errored seconds (LES) • Severely errored seconds (SES) • Unavailable errored seconds (UAS) • Bipolar violation (BPV) • Controlled slip (CS) • Line code violation (LCV)

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

Channelized OC12 PIC (M40e Router)



Software release	• Junos OS Release 5.2 and later For information on which FPCs support this PIC, see “PIC/FPC Compatibility (M40e Router)” on page 15.
Description	• One OC12 port • Power requirement: 0.23 A @ 48 V (10.8 W) • 12 DS3 channels • Supports IP version 4 (IPv4) unicast and multicast as well as MPLS, Intermediate System-to-Intermediate System (IS-IS), Open Shortest Path First (OSPF), and Border Gateway Protocol (BGP)
Hardware features	• ASIC-based, high-performance throughput on all ports • Integrated DSU functionality with subrate and scrambling support for each DS3 channel • Class-of-service support for each DS3 channel • Dual-router SONET automatic protection switching (APS) • Rate policing on input for each DS3 channel • Rate shaping output for each DS3 channel • Packet buffering, Layer 2 parsing

Software features	• M13/C-bit parity encoding
	• Full instrumentation per DS3 channel
	• DS3 diagnostics and loopback control
	• DS3 alarm and event counting and detection
	• DS3 Far-end Alarm and Control (FEAC) channel support
	• 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	• Duplex SC/PC connector (RX and TX) • SONET/SDH OC12/STM4 fixed transceivers: ◦ Intermediate Reach (IR-1) Optical interface support—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	• Alarm indication signal (AIS-L, AIS-P) • BERT functionality (you can configure one DS3 channel in BERT mode and configure the remaining channels to transmit and receive normal traffic) • Bit error rate signal degrade (BERR-SD), Bit error rate signal fail (BERR-SF) • Bit interleaved parity errors B1, B2, B3 (CV-S, CV-L, CV-P) • Equipment failure (Does not affect service) • Errored seconds (ES-S, ES-L, ES-P), far-end bit errors REI-L, REI-P (CV-LFE, CV-PFE), far-end block error (FEBE), 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) • Frame error • Idle code, Idle received • Loss of frame (LOF), Loss of pointer (LOP-P), Loss of signal (LOS) • Out of frame (OOF) • Payload Mismatch (PLM-P), payload unequipped (UNEQ-P) • Parity bit (P-bit) disagreements • Path parity error • Remote defect indication (RDI-L, RDI-P) • 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) • Yellow alarm bit (X-bit) disagreements

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

Channelized OC12/STM4 Enhanced IQ (IQE) PIC with SFP (M40e Router)

Figure 3: 1-Port IQE PIC

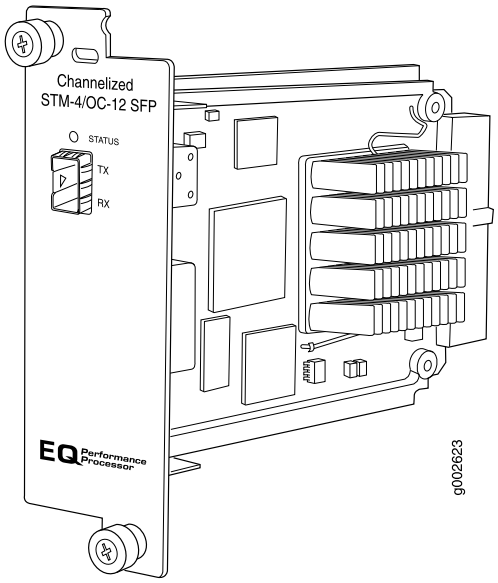
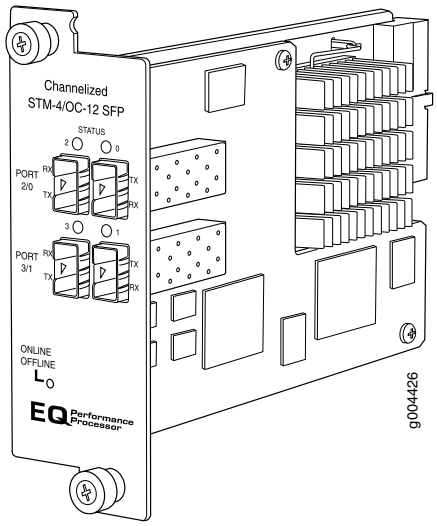


Figure 4: 4-Port IQE PIC



Software release	• 1-port: Junos OS Release 9.3 and later (Type 1) • 4-port: Junos OS Release 9.4 and later (Type 2) For information on which FPCs support these PICs, see “PIC/FPC Compatibility (M40e Router)” on page 15.

Description	• One or four OC12/STM4 ports
	• SONET or SDH is configurable on a per-port granularity
	• SONET channelization (1-port PIC):
	  ◦ 1 OC12 channel
	  ◦ 4 OC3 channels
	  ◦ 12 DS3 channels
	  ◦ 336 DS1 channels
	  ◦ 1011 DS0 channels
	• SDH channelization (1-port PIC):
	  ◦ 1 STM4 channel
	  ◦ 4 STM1 channels
	  ◦ 12 E3 channels
	  ◦ 252 E1 channels
	  ◦ 12 DS3 channels (Junos OS Release 10.1 and later)
	  ◦ 336 DS1 channels (Junos OS Release 10.1 and later)
	  ◦ 1011 DS0 channels
	• SONET channelization (4-port PIC):
	  ◦ 4 OC12 channel
	  ◦ 16 OC3 channels

	• 48 DS3 channels • 672 DS1 channels • 975 DS0 channels • SDH channelization (4-port PIC): • 4 STM4 channel • 16 STM1 channels • 48 E3 channels • 504 E1 channels • 48 DS3 channels (Junos OS Release 10.1 and later) • 672 DS1 channels (Junos OS Release 10.1 and later) • 975 DS0 channels • Power requirement: • 1-port: 0.64 A @ –48 V (30.7 W) • 4-port: 1.08 A @ –48V (52 W)
Hardware features	• 1-port: Port is numbered 0. • 4-port: 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	• Duplex LC/PC connector (Rx and Tx); single-mode fiber
	• SONET/SDH OC12/STM4 fiber-optic SFP transceivers:
	  • Short reach (model number: SFP-OC12-SR)
	  • Intermediate reach (IR-1) (model number: SFP-OC312-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 (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

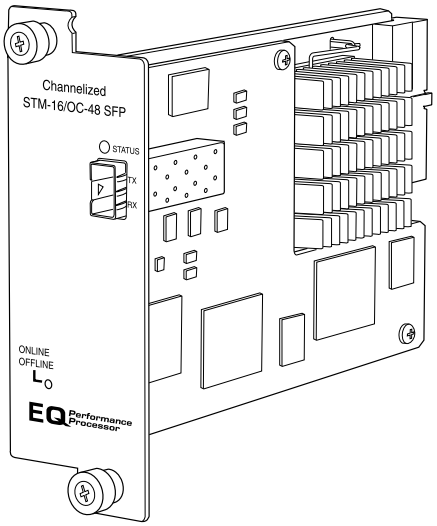
	• DS3 error detection:
	  • C-bit code violations (CCV)
	  • C-bit errored seconds (CES)
	  • C-bit severely errored framing seconds (CEFS)
	  • CRC errors
	  • Excessive zeros (EXZ)
	  • Far-end block error (FEBE)
	  • Far-end receive failure (FERF)
	  • Line errored seconds (LES)
	  • Parity bit (P-bit) 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

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

Channelized OC48/STM16 Enhanced IQ (IQE) PIC with SFP (M40e Router)



Software release	• Junos OS Release 9.4 and later (Type 2) For information on which FPCs support this PIC, see “PIC/FPC Compatibility (M40e Router)” on page 15.

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
	  ◦ 748 DS0 channels
	• SDH channelization:
	  ◦ 4 STM4 channel
	  ◦ 16 STM1 channels
	  ◦ 48 E3 channels
	  ◦ 504 E1 channels
	  ◦ 48 DS3 channels (Junos OS Release 10.1 and later)
	  ◦ 672 DS1 channels (Junos OS Release 10.1 and later)
	  ◦ 748 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	• Duplex LC/PC connector (Rx and Tx); single-mode fiber
	• SONET/SDH OC48/STM16 fiber-optic 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

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-RDI)
- Tributary unit—unequipped (TU-UNEQ)

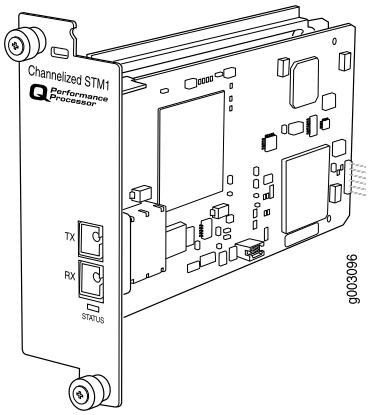
- DS1 alarms:
  - Alarm indication signal (AIS)
  - Loss of frame (LOF)
  - Remote alarm indication signal (RAIS)
- DS1 error detection:
  - Bursty errored seconds (BES)
  - CRC errors
  - Errored seconds (ES)
  - Line errored seconds (LES)
  - Loss of framing seconds (LOFS)
  - Severely errored seconds (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

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

Channelized STM1 IQ PIC (M40e Router)



Software release	• Junos OS Release 5.7 and later For information on which FPCs support this PIC, see “PIC/FPC Compatibility (M40e Router)” on page 15.
Description	• One STM1 port • Power requirement: 0.39 A @ 48 V (18.6 W) • Fine-grained queuing per logical interface • Channelization: STM1c, fractional E1, framed and unframed DS0
Hardware features	• Packet buffering, Layer 2 parsing • Local and remote loopback testing

Software features	• Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)
	• SNMP: SONET/SDH MIB, T1/E1 MIB
	• Dynamic, arbitrary channel configuration
	• Full bit error rate test (BERT) patterns at E1 and DS0 levels
	• Encapsulations:
	  ◦ High-Level Data Link Control (HDLC)
	  ◦ Frame Relay
	  ◦ Circuit cross-connect (CCC)
	  ◦ Translational cross-connect (TCC)
	  ◦ Point-to-Point Protocol (PPP)

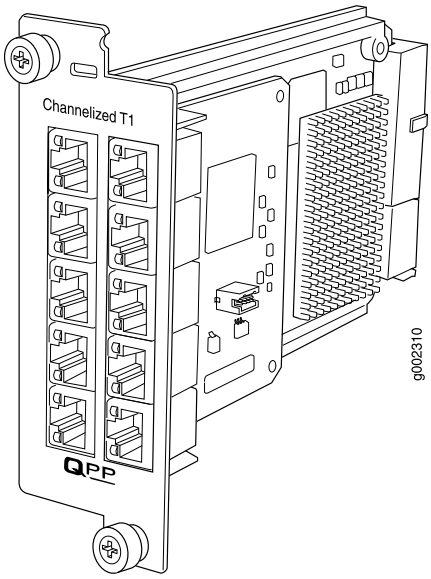
Cables and connectors	• Duplex SC/PC connector (Rx and Tx); single-mode intermediate-reach fiber
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events	• 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 errors B1, B2, B3 (CV-S, CV-L, CV-P) • 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: • 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)
Instrumentation (counters)	• Layer 2 per-queue and per-channel packet and byte counters

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

Channelized T1 IQ PIC (M40e Router)



Software release	• Junos OS Release 7.4 and later For information on which FPCs support this PIC, see “PIC/FPC Compatibility (M40e Router)” on page 15.
Description	• Ten T1 ports • Power requirement: 0.15 A @ 48 V (7.2 W) • Fine-grained queuing per logical interface • Channelization: T1, FT1, *N*xDS0

Hardware features	• Data service unit (DSU) and channel service unit (CSU) functionality
	• Ports configurable as clear channel T1 interfaces with 1.544-Mbps connectivity
	• Framing: Superframe (SF or D4) and Extended Superframe (ESF)
	• Supports B8ZS (bipolar 8-zero substitution) and AMI (alternate mark inversion) line coding
	• Local, remote, and payload loopback testing
	• ANSI T1.403 loopback support:
	  • Responds to embedded loopback commands upon receipt of an FDL command from remote end with loopup and loopdown at both line and payload level
	  • Insertion of loopback commands enables remote CSU/NIU/Smartjack to enter loopback and loopdown at both the line and payload level (ANSI and Telcordia)
	• Inband loopback support:
	  • Responds to inband loopback commands at both the line and payload level (ANSI and Telcordia)
	  • Insertion of inband loopback commands at both the line and payload level (ANSI and Telcordia)
	• Clocking support of external (line) and internal
	• Buildout support of the following ranges:
	  • 0 through 132 (Line buildout is from 1 through 132 feet)
	  • 133 through 265 (Line buildout is from 133 through 265 feet)
	  • 266 through 398 (Line buildout is from 266 through 398 feet)
	  • 399 through 531 (Line buildout is from 399 through 531 feet)
	  • 532 through 655 (Line buildout is from 532 through 655 feet)

Software features	• Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)
	• SNMP: T1 MIB and DS0 MIB
	• Dynamic, arbitrary channel configuration
	• Full bit error rate test (BERT) patterns at T1 and DS0 levels
	• Encapsulations:
	  • High-Level Data Link Control (HDLC)
	  • Frame Relay
	  • Circuit cross-connect (CCC)
	  • Translational cross-connect (TCC)
	  • Point-to-Point Protocol (PPP)

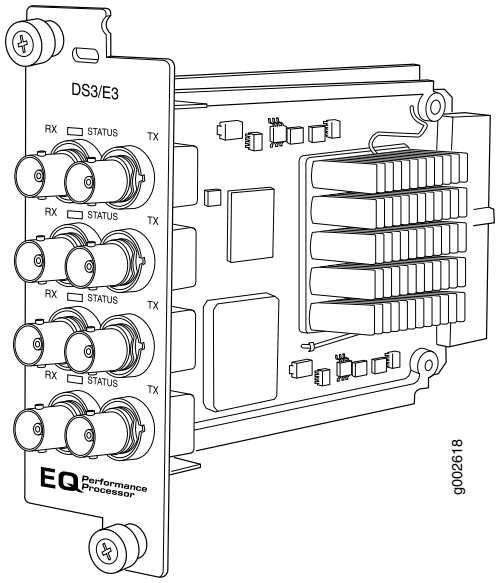
Cables and connectors	• 120-ohm RJ-48C connector (female)
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events	Alarms: • Alarm indication signal (AIS) • Bipolar violation (BPV) • Excessive zero (EXZ) • Line code violation (LCV) • Loss of frame (LOF) • Loss of signal (LOS) • Remote defect indication (RDI) Error detection: • Error seconds (ES) • Severely errored seconds (SES) • Severely errored frames (SEF) • Bit error event (BEE)
Instrumentation (counters)	• Layer 2 per-queue and per-channel packet and byte counters • 24–hour history or error counter updated at 15–minute intervals

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

DS3/E3 Enhanced IQ (IQE) PIC (M40e Router)



Software release	• Junos OS Release 9.3R2 and later For information on which FPCs support this PIC, see “PIC/FPC Compatibility (M40e Router)” on page 15.
Description	• Four DS3 or E3 ports • DS3 or E3 is configurable on a per-port granularity • Power requirement: 0.51 A @ 48 V (24.7 W)
Hardware features	• Ports are numbered 0 through 3 top to bottom
Software features	• Maximum transmission units (MTUs) of up to 9192 bytes • Subrate and scrambling: NOTE: Only DS3 interfaces support subrate and scrambling. ◦ Digital Link/Quick Eagle ◦ Kentrox ◦ Larscom ◦ ADTRAN ◦ Verilink (subrate: only port A mode) NOTE: For DS3 interfaces, Verilink does not function if an IQE interface is paired with an IQ interface. • Data service unit (DSU) functionality • B3ZS line encoding • Framing: M13, C-bit parity, framed clear channel • Full bit error rate test (BERT) • ANSI T1.403 FDL • Internal and loop clocking

	• DS3 far end alarm and control (FEAC) channel
	• Local line, remote line, and remote playback loopback testing
	• Simple Network Management Protocol (SNMP): DS3 MIB
	• 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.
	• 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

Cables and connectors	• Standard DS3 BNC coaxial cable interfaces
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	• DS3 alarms:
	  • Alarm indication signal (AIS)
	  • Loss of frame (LOF)
	  • Loss of signal (LOS)
	  • Phase lock loop (PLL)
	  • 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

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

E1 PICs (M40e Router)

Figure 5: E1 RJ-48 PIC

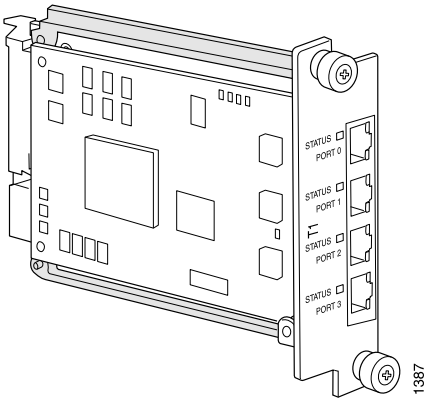
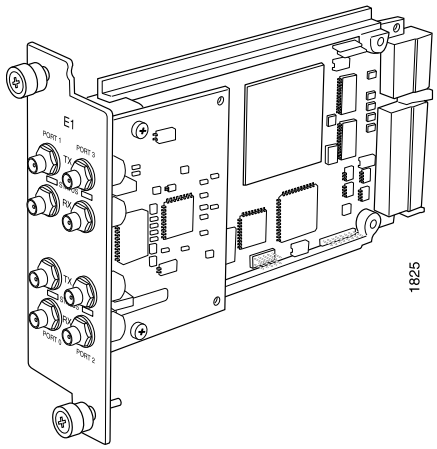


Figure 6: E1 coaxial PIC



Software release	• Junos OS Release 5.2 and later For information on which FPCs support this PIC, see “PIC/FPC Compatibility (M40e Router)” on page 15.

Description	• Four E1 or coaxial ports
	• Power requirement: 0.08 A @ 48 V (3.74 W)
	• Two versions:
	  ◦ 4-port, 120-ohm, RJ-48
	  ◦ 4-port, 75-ohm, coaxial
	• Onboard DSU functionality for E1 connectivity

Hardware features	• High-performance throughput on each port at speeds up to 2.048 Mbps, full duplex • Maximum transmission units (MTUs) of up to 4500 bytes • Per-interface diagnostics and loopback control • Per-interface shaping on output • Per-interface alarm and event counting and detection • HDB3 line coding • 4-bit CRC for G.704 framed mode • Per-port loop timing • Balanced and unbalanced modes • Packet buffering, Layer 2 parsing • Full bit error rate test (BERT)

Software features	• Integrated support for G.703 unframed mode and G.704 framed mode with CRC; this feature is user-configurable
	NOTE: The G.704 implementation supports speeds slower than 2.048 Mbps; multiple channels within a single E1 interface are not supported.
	• Configurable clock source: Internal or loop
	• Encapsulations:
	  ◦ High-Level Data Link Control (HDLC)
	  ◦ Frame Relay
	  ◦ Circuit cross-connect (CCC)
	  ◦ Point-to-Point Protocol (PPP)

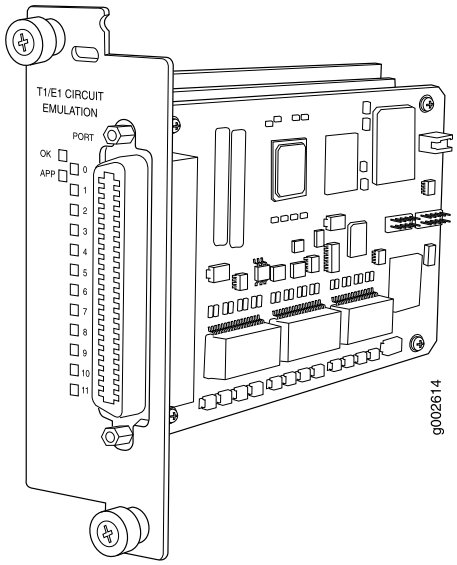
Cables and connectors	• Two versions:
	  ◦ Four RJ-48 connectors (one per port)
	  ◦ Four coaxial connectors
	• Custom 10-ft (3.05-m) posilock to BNC male cable, separate Rx and Tx

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	• Alarm indication signal (AIS) • Bipolar violations • Excessive zeros • Far-end block errors (FEBE, E-bit errors) • Loss of frame (LOF), Loss of signal (LOS) • Local and remote loopback diagnostics • Yellow alarm bit (X-bit) disagreements

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6
- RJ-48 Cable Pinouts for E1 and T1 PICs on the M40e Router

E1/T1 Circuit Emulation PIC (M40e Router)



Software release	• Junos OS Release 9.3 and later For information on which FPCs support this PIC, see “PIC/FPC Compatibility (M40e Router)” on page 15.
Description	• Configurable as either twelve E1 ports or twelve T1 ports NOTE: Mixing E1 and T1 ports on the same PIC is not supported. • Power requirement: 0.52 A @ 48 V (25 W) • Onboard DSU functionality for E1 connectivity

Hardware features	• Maximum transmission units (MTUs) of up to 1024 bytes
	• Per-interface diagnostics and loopback control
	• Per-interface alarm and event counting and detection
	• Framing
	  ◦ 4-bit CRC for G.704 framed mode
	  ◦ G.704 without CRC4
	  ◦ Unframed
	• Balanced and unbalanced modes
	• Full bit error rate test (BERT)

Software features

- PIC can be configured as twelve T1 ports or twelve E1 ports
- Local and remote loopback diagnostics
- E1 ports
  - High-performance throughput on each port at speeds up to 2048 Mbps, full duplex
  - HDB3 line encoding
  - Integrated support for G.704 framed mode with CRC; this feature is user-configurable

NOTE: The G.704 implementation supports speeds slower than 2.048 Mbps; multiple channels within a single E1 interface are not supported.

  - G.704 framed without CRC4
  - Unframed
  - Framed clear channel mode
  - Unframed clear channel mode
  - Framed fractional mode
- T1 ports
  - High-performance throughput on each port at speeds up to 1544 Mbps, full duplex
  - AMI and B8ZS line encoding
  - Framed clear channel mode
  - Fractional mode
  - Superframe (D4/SF) and extended superframe (ESF) framing
  - ESF CSU counters, WRT impairments, and CRC checking
  - Local DS1 line loopback, remote line loopback
- Loop timing, PIC line timing, and external timing
- Encapsulations: Structure-agnostic time-division multiplexing (TDM) over packet (SAToP) (RFC 4553)
- Pseudowire emulation edge-to-edge (PWE3) for ATM (RFC 4717) (Junos OS Release 9.6 and later)
- ATM Pseudowire emulation edge-to-edge via dynamic labels (LDP, RSVP-TE) (Junos OS Release 9.6 and later)
- Inverse mulitplexing (IMA) for ATM (Junos OS Release 10.0 and later)
- Simple Network Management Protocol (SNMP): ATM MIB for the Junos OS Release 10.2 and later
- ATM QoS for the Junos OS Release 10.2 and later:
  - Per-virtual circuit (VC) and per-virtual path (VP) traffic shaping
  - Unspecified bit rate (UBR) traffic shaping
  - Fine-grained real-time variable bit rate (rtVBR) and real-time variable bit rate (nrtVBR) traffic shaping
  - Port-level egress shaping
  - Constant bit rate (CBR)
  - Policing on a per virtual circuit basis
  - Independent peak cell rate (PCR) and sustained cell rate (SCR) policing
  - Counting, tagging, or discard policing actions

Cables and connectors

- RJ-21 connector
- Cables are rated for intra-building connections only.

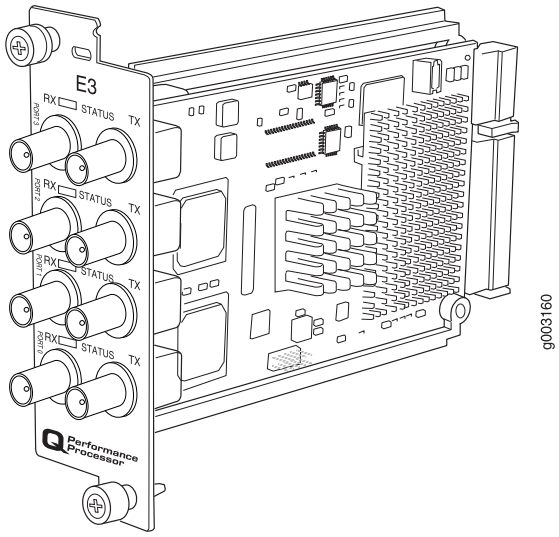
LEDs	OK or Status LED, one tricolor: • Off—PIC is offline and it is safe to remove it from the router. • Green—PIC is operating normally. • Yellow—PIC is initializing. • Red—PIC has an error or failure. APP LED, one bicolor: • Off—Monitoring application is not running. • Green—Monitoring application is running under acceptable load. 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	Structure-agnostic alarms for T1: • Alarm indication signal (AIS) • Loss of signal (LOS) • Errored seconds (ES) • Line code violation (LCV) • Line errored seconds (LES) • Severely errored seconds (SES) • Unavailable seconds (UAS) Structure-agnostic alarms for E1: • Alarm indication signal (AIS) • Errored seconds (ES) • Line code violation (LCV) • Line errored seconds (LES) • Severely errored seconds (SES) • Unavailable seconds (UAS) Structure aware alarms for E1: • Alarm indication signal (AIS) • Loss of frame (LOF) • Loss of signal (LOS) • Yellow alarm (remote alarm indication (RAI) (YLW) • Far-end block error (FEBE) • Cylical Redundancy Check (CRC) • CRC major • CRC minor • Line code violation (LCV) • Path code violation (LCV) • Errored seconds (ES) • Bursty errored seconds (BES) • Line errored seconds (LES) • Severely errored seconds (SES) • Severely errored frame seconds (SEFS) • Unavailable seconds (UAS)

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

E3 IQ PIC (M40e Router)



Software release	• Junos OS Release 6.1 and later For information on which FPCs support this PIC, see “PIC/FPC Compatibility (M40e Router)” on page 15.
Description	• Four E3 ports • Power requirement: 0.38 A @ 48 V (18 W) • Fine-grained queuing per logical interface

Hardware features	• Clear-channel (34.368-Mbps) and subrate E3
	• Unframed or ITU G.751 framing
	• Data service unit (DSU) functionality
	• Subrate and scrambling:
	  ◦ Digital Link/Quick Eagle
	  ◦ Kentrox
	• HDB3 line encoding
	• Full bit error rate test (BERT)
	• Local and remote loopback testing

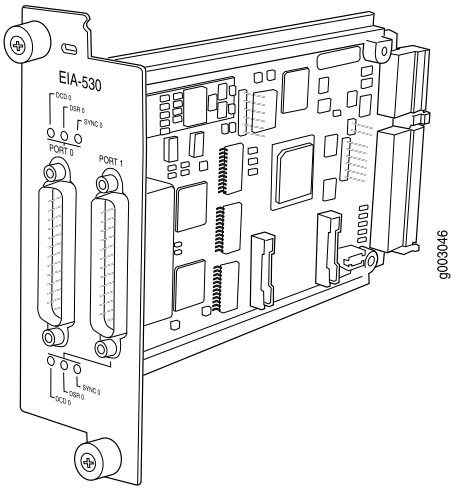
Software features	• Quality of service (QoS) per port: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)
	• Simple Network Management Protocol (SNMP): E3 MIB, QoS MIB
	• Input policing and output shaping
	• Provider-side rate limiting
	• Full data link connection identifier (DLCI) range with sparse channel numbering
	• Per-DLCI queues with weighted deficit round-robin and strict priority
	• Encapsulations:
	  ◦ High-Level Data Link Control (HDLC)
	  ◦ Frame Relay
	  ◦ Circuit cross-connect (CCC)
	  ◦ Translational cross-connect (TCC)
	  ◦ Point-to-Point Protocol (PPP)
	• Junos OS Release 7.0 or later is required to configure graceful Routing Engine switchover (GRES).

Cables and connectors	• Standard E3 BNC coaxial cable interfaces
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	• Alarm indication signal (AIS) • Equipment failure (does not affect service) • Frame error • Line code violation • Loss of signal (LOS) • Out of frame (OOF) • Yellow alarm bit (A-bit) disagreements
Instrumentation (counters)	• Layer 2 per-queue packet and byte counters

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

EIA-530 PIC (M40e Router)



Software release	• Junos OS Release 5.6 and later For information on which FPCs support this PIC, see “PIC/FPC Compatibility (M40e Router)” on page 15.
Description	• Two EIA-530, X.21 or V.35 serial ports • Power requirement: 0.07 A @ 48 V (3.4 W)
Hardware features	• Configured as data terminal equipment (DTE) ports • Resynchronization signal • Receives clock rates up to 16 Mbps • Local, data communications equipment (DCE) local, and DTE remote loopbacks

Software features	• Supports four queues per port
	• Random early detection (RED)
	• Transmitter Signal Element Timing is looped from the timing received on the Transmitted Signal Element DCE. EIA-530 ports support the ability to invert the Transmit Data Element. The EIA-530 ports support the following rates:
	  ◦ 2.048 Mbps
	  ◦ 2.341 Mbps
	  ◦ 2.731 Mbps
	  ◦ 3.277 Mbps
	  ◦ 4.09 Mbps
	  ◦ 5.461 Mbps
	  ◦ 8.192 Mbps
	  ◦ 16.384 Mbps
	• V.35 ports support up to 2.048 Mbps
	• X.21 ports support up to 10 Mbps
	• 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	• Two DB-25 male connectors (one per port, included with PIC) • V.35 requires an EIA-530 to V.35 cable and connects to a V.35 DTE 34-pin Winchester type male cable (one per port) • X.21 requires an EIA-530 to X.21 cable and connects to a X.21 DTE DB-15 male cable

LEDs	Three bicolor per port:
	• Data set ready (DSR):
	  ◦ Green—DSR is detected or ignored
	  ◦ Red—DSR expected but not present
	• Data carrier detect (DCD):
	  ◦ Green—DCD is detected or ignored
	  ◦ Red—DCD expected but not present
	• Resynchronization:
	  ◦ Green—Keepalives are being received
	  ◦ Red—Data terminal ready (DTR) toggled from low to high (resynchronization pulses are being sent)

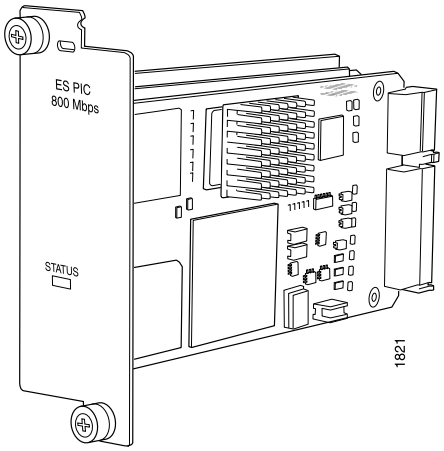
Instrumentation (counters)	• Per-port packet and byte counters
	• Resynchronization counters:
	  ◦ Number of resynchronizations initiated
	  ◦ Time of last resynchronization

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5

- M40e PICs Supported on page 6
- M40e X.21 and V.35 Cable Pinouts for EIA-530 PIC

ES PIC (M40e Router)



Software release	• Junos OS Release 5.2 and later For information on which FPCs support this PIC, see "PIC/FPC Compatibility (M40e Router)" on page 15.
Description	• High-bandwidth encryption (in accordance with IPSec standards) • Power requirement: 0.21 A @ 48 V (10 W) • Support for IPSec encryption, decryption, and key calculation acceleration NOTE: The ES PIC does not support reassembly and decryption of encrypted packets that were fragmented in an IPSec tunnel.
Hardware features	• Extends the existing security functionality to Internet traffic at high-performance rates • Throughput at 800 Mbps, half duplex • 1000 IPSec tunnels or 2000 IPSec security association (SA) pairs • Supports MTUs of up to 3900 bytes
Software features	For a list of the software features available for services PICs, see the *Junos OS Services Interfaces Configuration Guide*. • Support for IPv4 • Authentication hash algorithms: MD-5 and SHA-1 • Encryption algorithms: DES, 3-DES, and Null • Automated key management using Diffie-Hellman key establishment • Support for preshared key management • Authentication Header and Encapsulating Security Payload (ESP) independently or in bundle mode • Tunnel mode IPSec encryption and decryption for data traffic • Transport mode IPSec encryption and decryption for control traffic • Static and dynamic security associations (SA) supported • SA lifetime configurable in seconds and kilobytes • Junos OS Release 7.0 or later is required to configure graceful Routing Engine switchover (GRES).

LEDs	One tricolor: • 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
Instrumentation (counters)	• Input and output bytes per tunnel • Total authentication failures • Total antireply failures • Total encryption ASIC errors per PIC

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

Fast Ethernet PICs (M40e Router)

Figure 7: 4-Port Fast Ethernet PIC

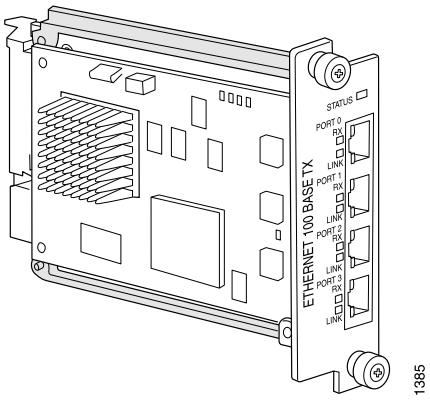


Figure 8: 8-Port Fast Ethernet PIC

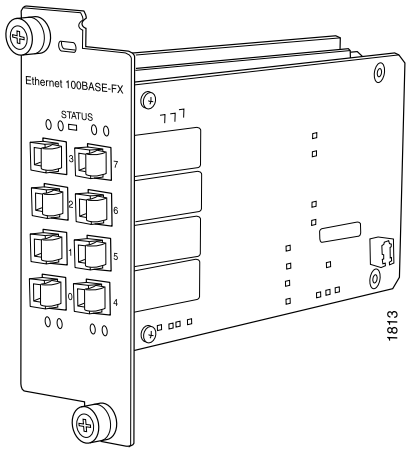


Figure 9: 12-Port Fast Ethernet PIC

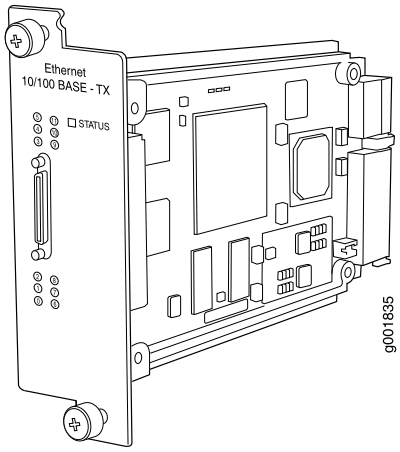


Figure 10: 48-Port Fast Ethernet PIC

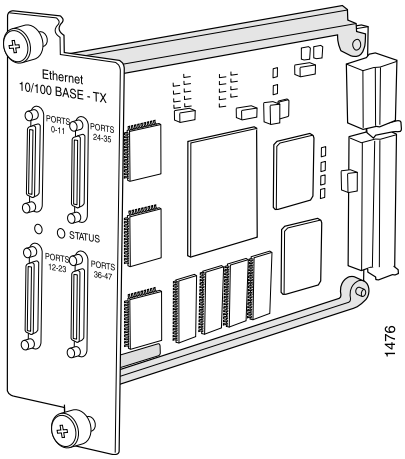
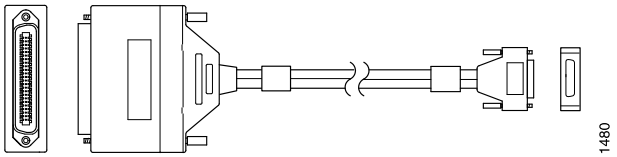


Figure 11: VHDCI-to-RJ-21 Cable



Software release	• 4-port, 8-port, 48-port: Junos OS Release 5.2 and later • 12-port: Junos OS Release 5.4 and later For information on which FPCs support these PICs, see "PIC/FPC Compatibility (M40e Router)" on page 15.

Description	• 4 100Base-TX ports
	• 8 100Base-FX ports
	• 12 100Base-TX ports
	• 48 100Base-TX ports
	• Power requirement:
	  • 4-port: 0.14 A @ 48 V (6.8 W)
	  • 8-port: 0.26 A @ 48 V (12.5 W)
	  • 12-port: 0.23 A @ 48 V (11 W)
	  • 48-port: 0.69 A @ 48 V (33.3 W)

Hardware features	• High-performance throughput on each port at speeds up to 100 Mbps • Source and destination Media Access Control (MAC) address filtering • RMON EtherStats packet buffering • 802.3 Ethernet standard compliant • 4-port PICs MTUs up to 9192 bytes; 8-port, 12-port, and 48-port PICs support MTUs up to 1532 bytes • 4-port PICs support 1,024 802.1Q VLANs per port; 8-port, 12-port, and 48-port PICs support 16 802.1Q VLANs per port
Software features	• Autosensing full-duplex and half-duplex modes • Virtual Router Redundancy Protocol (VRRP) • 802.1q virtual LANs (VLANs) • Circuit cross-connect (CCC) VLAN
Cables and connectors	4-port PIC: • Connector: Two-pair, Category 5 unshielded twisted-pair connectivity through an RJ-45 connector • Pinout: MDI noncrossover 8-port PIC: • Connector: MT-RJ female • FX optical interface—see Gigabit Ethernet 1000BASE Optical Interface Specifications 12-port PIC: • Connector: One very high density connector interface (VHDCI) to RJ-21 cable that connects to an RJ-45 patch panel

48-port PIC:

- VHDCI-to-RJ-21 cables that connect to an RJ-45 patch panel
- Four VHDCI connectors that each service 12 10/100 ports

NOTE: Each of the four connectors on a Fast Ethernet 48-port PIC can support a maximum of approximately 800 Mbps. However, this constitutes oversubscription. Use this PIC only in environments that can support this level of oversubscription.

LEDs

Status LED, one bicolor:

- Off—PIC ports not enabled
- Green—PIC is operating normally
- Red—PIC has an error or failure

4-port PIC—One pair of port LEDs:

- Link LED—If green, the port is online; if there is no light, the port is down
- RX LED—If flashing green, the port is receiving data; if there is no light, the port might be on but is not receiving data

8-port PIC—one pair of port LEDs per port:

- Port link LED—If green, the port is online; if there is no light, the port is down

NOTE: The Link LED remains lit on the 8-port PIC when the port is down.

- Port RX LED—If flashing green, the port is receiving data; if there is no light, the port might be on, but is not receiving data

12-port PIC—one port LED per port:

- Green—100-Mbps link established
- Flashing green—100-Mbps activity
- Yellow—10-Mbps link established
- Flashing yellow—10-Mbps activity
- Off—No link present

NOTE: The port LEDs remain lit on the 12-port PIC when the ports are down.

NOTE: The 48-port PIC does not have port LEDs. To check port status on a 48-port PIC, use the **show interfaces fe-*fpc/pic/port*** command. For more information about this command, see the *Junos OS Network Interfaces Configuration Guide*.

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6
- M40e Fast Ethernet PIC 48-port Cable Pinouts

Gigabit Ethernet PICs with SFP (M40e Router)

Figure 12: 1-Port Gigabit Ethernet PIC

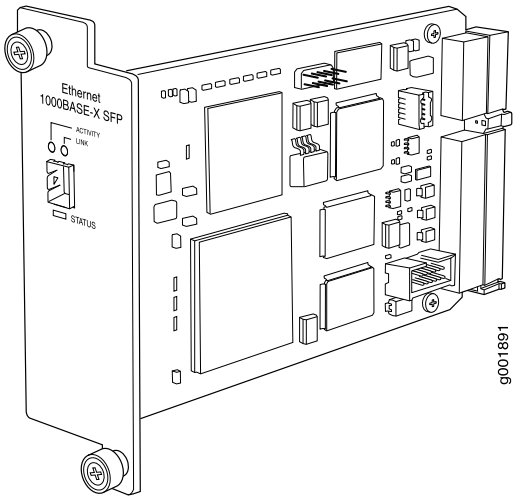


Figure 13: 2-Port Gigabit Ethernet PIC

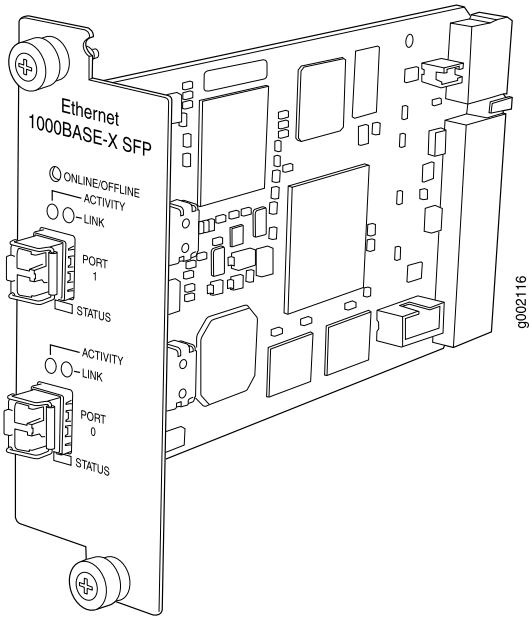
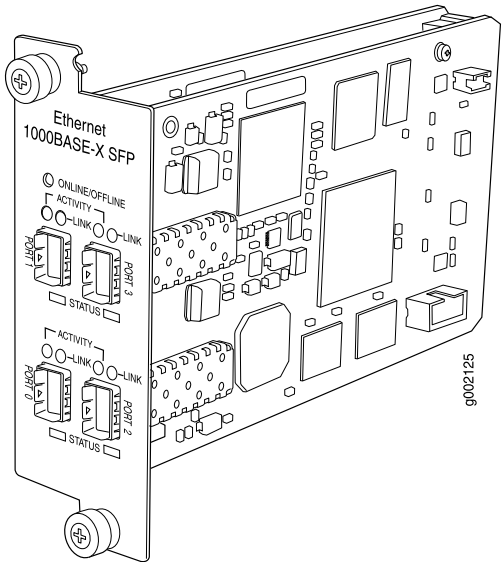


Figure 14: 4-Port Gigabit Ethernet PIC



Software release	• 1-port: Junos OS Release 6.3 and later • 2-port: Junos OS Release 6.4 and later • 4-port: Junos OS Release 7.0 and later For information on which FPCs support these PICs, see “PIC/FPC Compatibility (M40e Router)” on page 15.

Description	• One, two, or four Gigabit Ethernet ports
	• Power requirement:
	  • 1-port: 0.15 A @ 48 V (7.3 W)
	  • 2-port: 0.25 A @ 48 V (11.9 W)
	  • 4-port: 0.50 A @ 48 V (23.8 W)
	• Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network

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	• Virtual Router Redundancy Protocol (VRRP) support • 802.1q virtual LANs (VLANs) support • 960 destination MAC filters per port • Optical diagnostics and related alarms on the 2-port and 4-port PICs (Junos OS Release 8.2 and later) • Flexible Ethernet encapsulation • Multiple tag protocol identifiers (TPID) support • Source MAC learning • MAC accounting and policing—Dynamic local address learning of source MAC addresses

Cables and connectors	• You can install any transceiver supported by the PIC.
	• Fiber-optic SFP transceivers:
	  ◦ Duplex LC/PC connector (Rx and Tx)
	  ◦ Small form-factor pluggable (SFP) transceivers:
	  ▪ 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 transceivers:
	  ◦ Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
	  ◦ 1000Base-T (model number: SFP-1-GE-T)
	  Optical interface specifications—see Gigabit Ethernet 1000BASE Optical Interface Specifications
	NOTE: Do not install Gigabit Ethernet SFPs in the SONET/SDH port. The port will not recognize the SFP.

LEDs	Status LED, one bicolor: • Off—PIC is not enabled • Green—PIC is operating normally • Red—PIC has an error or failure Port LEDs, one pair per port: • Link—If green, the port is online; if there is no light, the port is down • Activity—If flashing green, the port is receiving data; if there is no light, the port might be on but is not receiving data

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

Gigabit Ethernet IQ PICs with SFP (M40e Router)

Figure 15: 1-Port Gigabit Ethernet IQ PIC

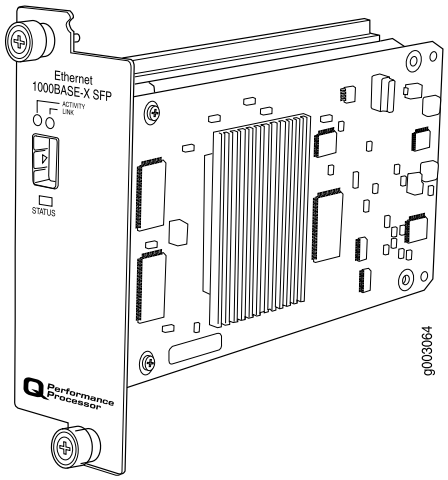
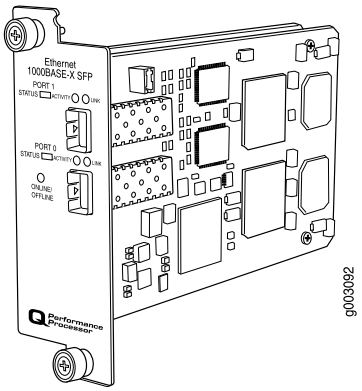


Figure 16: 2-Port Gigabit Ethernet IQ PIC



Software release	• 1-port: Junos OS Release 6.0 and later • 2-port: Junos OS Release 6.1 and later For information on which FPCs support these PICs, see “PIC/FPC Compatibility (M40e Router)” on page 15.
Description	• One or two Gigabit Ethernet ports • Power requirement: 0.46 A @ 48 V (22 W) • Fine-grained queuing per logical interface
Hardware features	• High-performance throughput on each port at speeds up to 1 Gbps • Full-duplex mode • Large MTUs of up to 9192 bytes
Software features	• Optical diagnostics and related alarms • Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) • Virtual Router Redundancy Protocol (VRRP) support • 802.1q virtual LANs (VLANs) • VLAN stacking and rewriting • Flexible Ethernet encapsulation • MAC policing, accounts, and filters • Junos OS Release 7.0 or later is required to configure graceful Routing Engine switchover (GRES).

Cables and connectors	• You can install any transceiver supported by the PIC.
	• Fiber-optic SFP transceivers:
	  • Duplex LC/PC connector (Rx and Tx)
	  • Small form-factor pluggable (SFP) transceivers:
	  • 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 transceivers:
	  • Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
	  • 1000Base-T (model number: SFP-1-GE-T)
	  Optical interface specifications—see Gigabit Ethernet 1000BASE Optical Interface Specifications
	NOTE: Do not install SONET/SDH OC48c/STM16 SFPs in the Gigabit Ethernet port. The port will not recognize the SFP.

LEDs	Status LED, one tricolor: • 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. NOTE: The green status LED is lit on the 2-port Gigabit Ethernet IQ PIC when at least one port is online. Port LEDs, one per port: • Off—Port is down. • Green—Link is established.

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

Gigabit Ethernet IQ2 PICs with SFP (M40e Router)

Figure 17: 4-Port Gigabit Ethernet IQ2 PIC

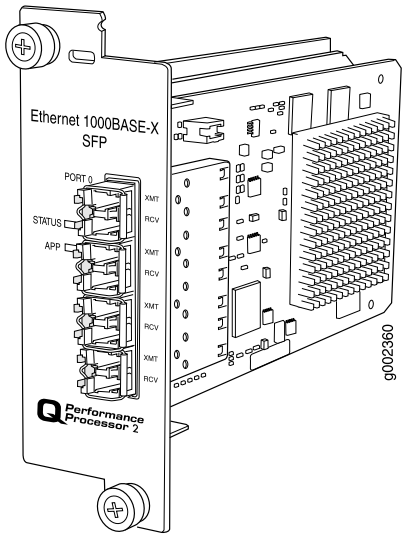
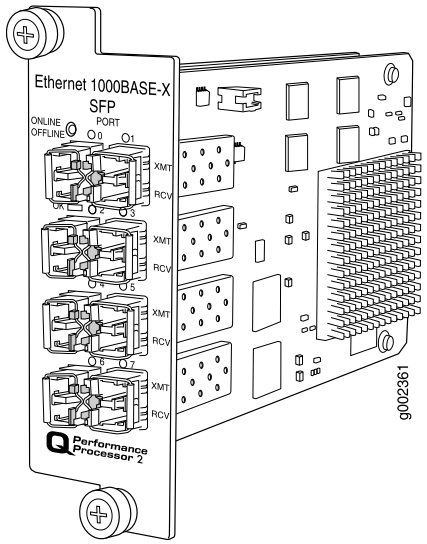


Figure 18: 8-Port Gigabit Ethernet IQ2 PIC



Software release	• 4-port with SFP: Junos OS Release 7.6R3 and later (Type 1) • 8-port with SFP: Junos OS Release 7.6R2 and later (Type 2) For information on which FPCs support these PICs, see “PIC/FPC Compatibility (M40e Router)” on page 15.

Description	• Four or eight Gigabit Ethernet ports
	• Power requirement:
	  ◦ 4-port: 0.65 A @ 48 V (31 W)
	  ◦ 8-port: 0.89 A @ 48 V (42.5 W)

Hardware features	• High-performance throughput on each port:
	  ◦ 4-port with SFP: speeds up to 1 Gbps
	  ◦ 8-port with SFP: speeds up to 4 Gbps
	• Full-duplex mode
	• Large maximum transmission units (MTUs) of up to 9192 bytes

Software features	• Intelligent handling of oversubscribed traffic • Optical diagnostics and related alarms • Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) • Virtual Router Redundancy Protocol (VRRP) support • Hierarchical shaping • Fine-grained queuing and shaping per logical interface at both ingress and egress • 802.1q virtual LANs (VLANs) • VLAN stacking and rewriting • Channels defined by two stacked VLAN tags • Multiple tag protocol identifiers (TPID) support • IP service for nonstandard TPID and stacked VLAN tags • 802.1p rewrite per channel • Flexible mapping of channels and scheduler resources at both ingress and egress • Flexible Ethernet encapsulation • MAC learning, policing, accounting, and filtering

Cables and connectors	• You can install any transceiver supported by the PIC.
	NOTE: Do not install SONET/SDH SFPs in the Gigabit Ethernet port. The port will not recognize the SFP.
	• Fiber-optic small form-factor pluggable transceivers (SFPs):
	  • Duplex LC/PC connector (Rx and Tx)
	  • Small form-factor pluggable (SFP) transceivers:
	  • 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 transceivers:
	  • Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
	  • 1000Base-T (model number: SFP-1-GE-T)
	Optical interface specifications—see Gigabit Ethernet 1000BASE Optical Interface Specifications

LEDs	OK or Status LED, one tricolor: • Off—PIC is offline and it is safe to remove it from the router. • Green—PIC is operating normally. • Yellow—PIC is initializing. • Red—PIC has an error or failure. APP LED, one bicolor: • Off—Monitoring application is not running. • Green—Monitoring application is running under acceptable load. Port LEDs, one per port: • Off—Port is not enabled. • Green—Port is online with no alarms or failures.

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

Gigabit Ethernet Enhanced IQ2 (IQ2E) PICs with SFP (M40e Router)

Figure 19: 4-Port Gigabit Ethernet IQ2E PIC

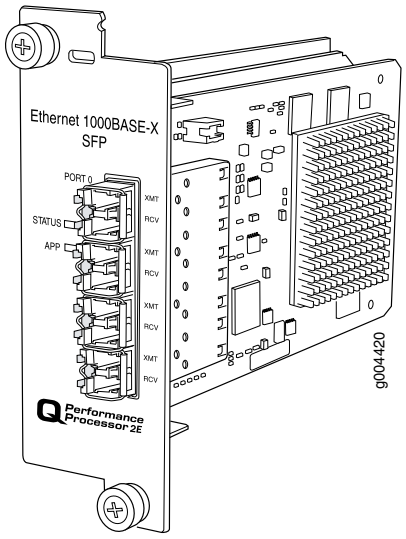
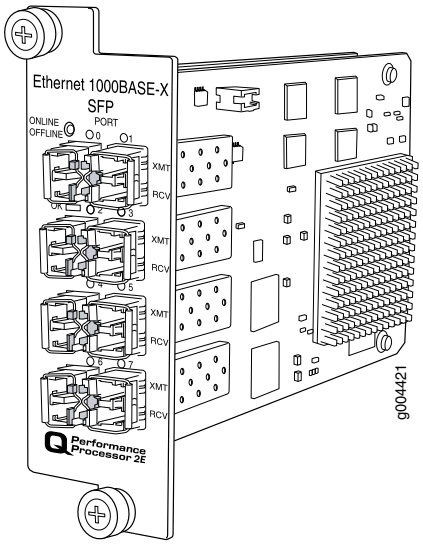


Figure 20: 8-Port Gigabit Ethernet IQ2E PIC



Software release	• 4-port with SFP: Junos OS Release 9.4 and later (Type 1) • 8-port with SFP: Junos OS Release 9.4 and later (Type 2) For information on which FPCs support these PICs, see “PIC/FPC Compatibility (M40e Router)” on page 15.

Description	• Four or eight Gigabit Ethernet ports
	• Power requirement:
	  ◦ 4-port: 0.67 A @ 48 V (32 W)
	  ◦ 8-port (Type 2): 0.92 A @ 48 V (44 W)

Hardware features	• High-performance throughput on each port:
	  ◦ 4-port with SFP: speeds up to 1 Gbps
	  ◦ 8-port with SFP: speeds up to 4 Gbps
	• Full-duplex mode
	• Large maximum transmission units (MTUs) of up to 9192 bytes

Software features	• Intelligent handling of oversubscribed traffic • Optical diagnostics and related alarms • Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) • Drop statistics reported per queue for each of four priority-based drop profiles • Four levels of strict priorities with priority propagation among scheduling levels • Virtual Router Redundancy Protocol (VRRP) support • Hierarchical shaping and hierarchical scheduler • Fine-grained queuing and shaping per logical interface at both ingress and egress • 802.1q virtual LANs (VLANs) • VLAN stacking and rewriting • Channels defined by two stacked VLAN tags • Multiple tag protocol identifiers (TPID) support • IP service for nonstandard TPID and stacked VLAN tags • 802.1p rewrite per channel • Flexible mapping of channels and scheduler resources at both ingress and egress • 16,000 schedulers (2,000 schedulers with 8 queues each or 4,000 schedulers with 4 queues each) • Scheduler resources dynamically allocated across ports • Flexible Ethernet encapsulation • MAC learning, policing, accounting, and filtering

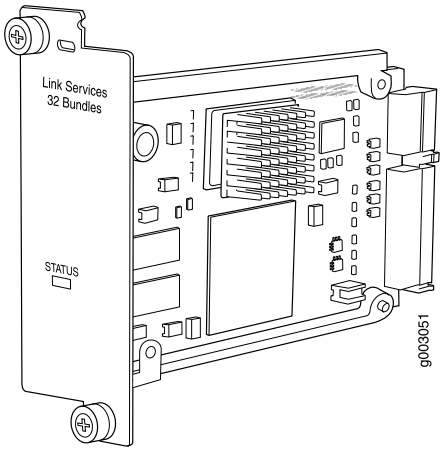
Cables and connectors	• You can install any transceiver supported by the PIC.
	NOTE: Do not install SONET/SDH SFPs in the Gigabit Ethernet port. The port will not recognize the SFP.
	• Fiber-optic small form-factor pluggable transceivers (SFPs):
	  ◦ Duplex LC/PC connector (Rx and Tx)
	  ◦ Small form-factor pluggable (SFP) transceivers:
	  ▪ 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 transceivers:
	  ◦ Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
	  ◦ 1000Base-T (model number: SFP-1-GE-T)
	  Optical interface specifications—see Gigabit Ethernet 1000BASE Optical Interface Specifications

LEDs	OK or Status LED, one tricolor: • Off—PIC is offline and it is safe to remove it from the router. • Green—PIC is operating normally. • Yellow—PIC is initializing. • Red—PIC has an error or failure. APP LED, one bicolor: • Off—Monitoring application is not running. • Green—Monitoring application is running under acceptable load. Port LEDs, one per port: • Off—Port is not enabled. • Green—Port is online with no alarms or failures.

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

Monitoring Services II PIC (M40e Router)



Software release	• Junos OS Release 6.0 and later For information on which FPCs support this PIC, see "PIC/FPC Compatibility (M40e Router)" on page 15.
Description	• Passive traffic monitoring or flow collection services • Power requirement: 0.4 A @ 48 V (19 W) • Monitors IPv4 packets • Support for collecting and exporting cflowd records
Hardware features	• Monitors up to 400,000 packets per second • Support for MTUs up to 4474 bytes for SONET interfaces

Software features	For more information about the software features for services PICs, see the *Junos OS Services Interfaces Configuration Guide*.
	• Load distribution across multiple PICs
	• Active monitoring cflowd version 5 support
	• Provides start and end times of each export
	• Encapsulations:
	  • Multilink Frame Relay (MLFR)
	  • Multilink Point-to-Point Protocol (MLPP)
	• Supports firewall filtering and filter-based forwarding (FBF)
	NOTE: Flow collection services are supported in Junos OS Release 6.2 and later.
	NOTE: This PIC does not support graceful Routing Engine switchover.

Cables and connectors	• None

LEDs	Status LED, one tricolor: • Off—PIC is offline and it is safe to remove it from the chassis. • Green—PIC is operating normally. • Yellow—PIC is initializing. • Red—PIC has an error or failure and no further harm can be done by removing it from the chassis. Application LED, one bicolor: • Off—Flow collector is not running. • Green—Flow collector is running under acceptable load. • Yellow—Flow collector is overloaded.

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

Multiservices PICs (M40e Router)

Figure 21: Multiservices 100 PIC

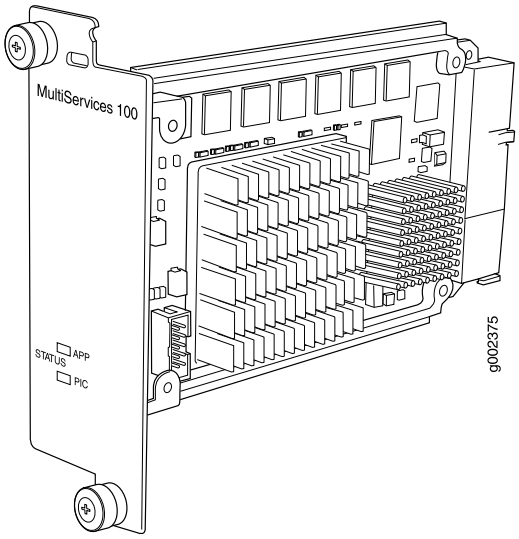
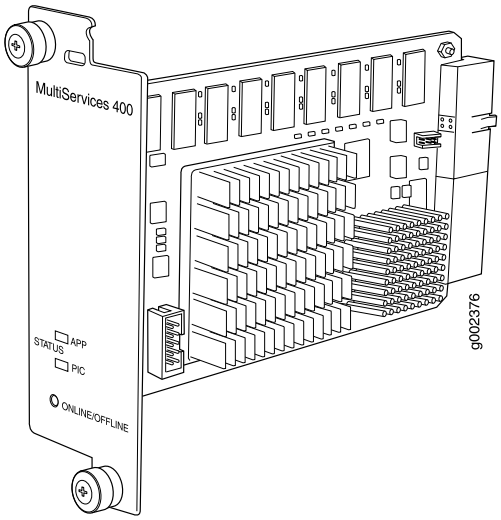


Figure 22: Multiservices 400 PIC



Software release	• Multiservices 100: Junos OS Release 8.1 and later (Type 1) • Multiservices 400: Junos OS Release 8.1R2 and later (Type 2) For information on which FPCs support these PICs, see “PIC/FPC Compatibility (M40e Router)” on page 15.

Description	• Supports tunnel services. This feature is included with the PIC and does not require an individual license.
	• Individual licenses must be purchased for additional services.
	• Power requirement:
	  ◦ Type 1: 0.52 A @ 48 V (25 W)
	  ◦ Type 2: 0.69 A @ 48 V (33 W)

Hardware features	• Active monitoring on:
	  ◦ Type 1: up to 1.6 million flows
	  ◦ Type 2: up to 3.2 million flows

Software features	• Support for up to 2000 service sets • Support for MTUs up to 9192 bytes for Gigabit Ethernet and SONET interfaces Depending on your Junos OS Release and individual licenses, software features for this PIC can include the features listed in Table 4 on page 104. For more information about the software features available for services PICs, see the *Junos OS Services Interfaces Configuration Guide*.

LEDs	Status LED, one tricolor: • Off—PIC is offline and it is safe to remove it from the chassis. • Green—PIC is operating normally. • Yellow—PIC is initializing. • Red—PIC has an error or failure and no further harm can be done by removing it from the chassis. Application LED, one bicolor: • Off—Service is not running. • Green—Service is running under acceptable load. • Yellow—Service is overloaded.

Table 4: Multiservices PICs Software Features Supported by the M40e Router

Software Feature	Multiservices 100	Multiservices 400
GRE Key	–	–
GRE dont-fragment	–	–
Stateful firewall with packet inspection: detects SYN attacks, ICMP and UDP floods, and ping-of-death attacks	8.1	8.1R2
Network Address Translation (NAT) for IP addresses	8.1	8.1R2
Port Address Translation (PAT) for port numbers	8.1	8.1R2
IP Security (IPSec) encryption	8.1	8.1R2
Active flow monitoring exports cflowd version 5 and version 8 records	8.1	8.1R2
Active flow monitoring exports flow monitoring version 9 records, based on RFC 3954	8.3	8.3
Passive flow monitoring	–	8.4
Passive flow collection	–	8.5
Flow-tap	8.1	8.1R2
Dynamic flow capture	–	–
Real-time performance monitoring	8.2	8.2
Link services	8.1	8.1R2

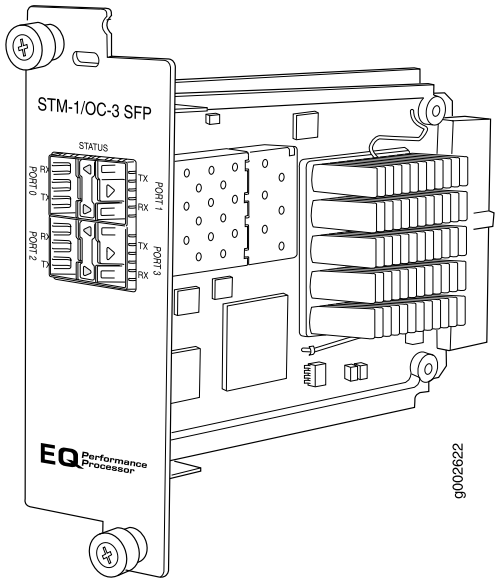
Table 4: Multiservices PICs Software Features Supported by the M40e Router *(continued)*

Software Feature	Multiservices 100	Multiservices 400
Tunnel services: • IP-IP unicast tunneling • GRE unicast tunneling—Supports GRE fragmentation • Protocol Independent Multicast (PIM) sparse mode unicast tunneling	8.1	8.1R2
Virtual tunnel interface for Layer 3 VPNs	8.1	8.1R2
Layer 2 Tunneling Protocol (L2TP)	–	–
Voice services: • Compressed Real-Time Transport Protocol (CRTP)	8.1	8.1R2
Encapsulations: • Multilink Frame Relay (MLFR) • Multilink Point-to-Point Protocol (MLPP)	8.1	8.1R2

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

SONET/SDH OC3/STM1 Enhanced IQ (IQE) PIC with SFP (M40e Router)



Software release	• Junos OS Release 9.3R2 and later (Type 1) For information on which FPCs support this PIC, see “PIC/FPC Compatibility (M40e Router)” on page 15.
Description	• Four OC3 or STM1 ports • SONET or SDH is configurable on a per-port granularity • Power requirement: 0.6 A @ 48 V (28.8 W)
Hardware features	• Top row: Ports are numbered 0 and 1 from left to right • Bottom row: Ports are numbered 2 and 3 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.
	• Packet buffering, Layer 2 parsing
	• Local line and remote payload loopback testing
	• Simple Network Management Protocol (SNMP): OC3 MIB
	• 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

Cables and connectors	• Duplex LC/PC connector (Rx and Tx)
	• SONET/SDH OC3/STM1 fiber-optic 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

LEDs	One tricolor **Status** 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)
	  • Loss of frame (LOF)
	  • Loss of light (LOL)
	  • Loss of pointer (LOP)

- Loss of signal (LOS)
- Payload label mismatch (PLM-P)
- Phase lock loop (PLL)
- 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)
- Severely errored frames (SEF)

- 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 frames (SEF)
- Error detection:
  - Errored seconds (ES-S, ES-L, ES-P)
  - Severely errored framing seconds (SEFS-S)
  - Severely errored seconds (SES-S, SES-L, SES-P)
  - Unavailable seconds (UAS-L, UAS-P)

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

SONET/SDH OC3/STM1 (Multi-Rate) PICs with SFP (M40e Router)

Figure 23: SONET/SDH OC3/STM1 (Multi-Rate) PIC (Type 1)

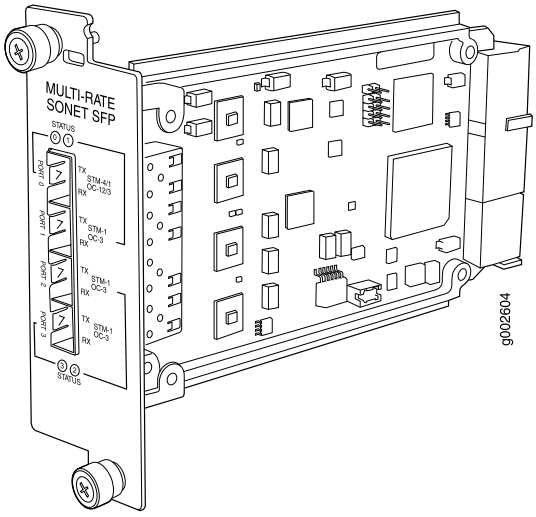
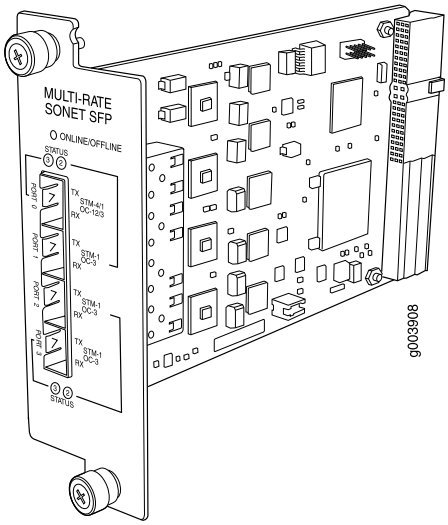


Figure 24: SONET/SDH OC3/STM1 (Multi-Rate) PIC (Type 2)



Software release	• 4-port: Junos OS Release 8.4 and later (Type 1) • 4-port: Junos OS Release 8.3 and later (Type 2) For information on which FPCs support these PICs, see “PIC/FPC Compatibility (M40e Router)” on page 15.

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
	• Dual-router automatic protection switching (APS)
	• Multiprotocol Label Switching (MPLS) fast reroute
	• Alarm and event counting and detection
	• 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.
	• 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 (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*.

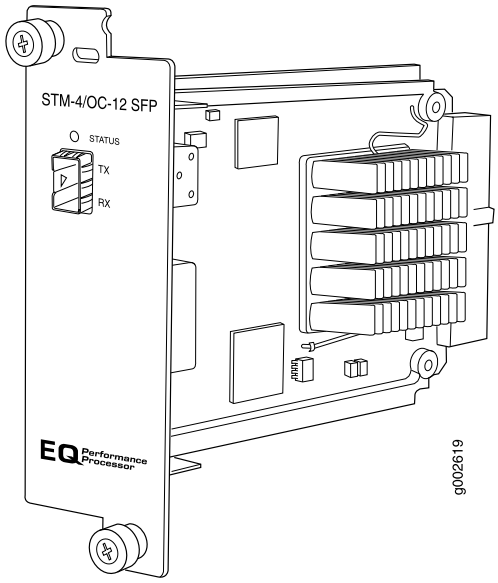
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

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 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

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

SONET/SDH OC12/STM4 Enhanced IQ (IQE) PIC with SFP (M40e Router)



Software release	• Junos OS Release 9.3 and later (Type 1) For information on which FPCs support this PIC, see "PIC/FPC Compatibility (M40e Router)" on page 15.
Description	• One OC12/STM4 port • SONET or SDH is configurable on a per-port granularity • Power requirement: 0.58 A @ 48 V (27.8 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.
	• Packet buffering, Layer 2 parsing
	• Local line and remote payload loopback testing
	• 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	• Duplex LC/PC connector (Rx and Tx)
	• SONET/SDH OC12/STM4 fiber-optic SFP transceivers:
	  • Short reach (model number: SFP-OC12-SR)
	  • Intermediate reach (IR-1) (model number: SFP-OC312-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)
	• 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)

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

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

SONET/SDH OC12/STM4 (Multi-Rate) PICs with SFP (M40e Router)

Figure 25: 1-Port SONET/SDH OC12/STM4 (Multi-Rate) PIC

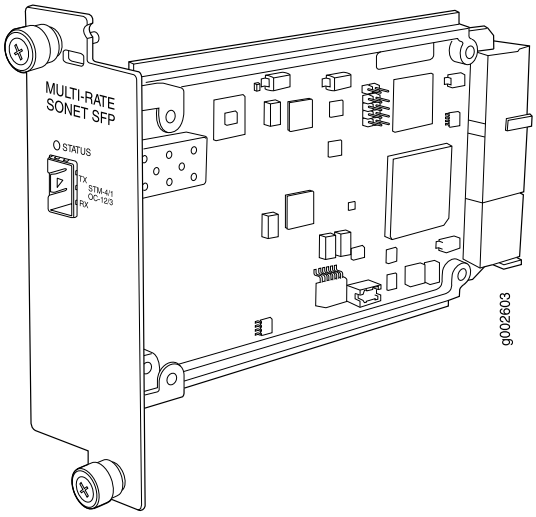
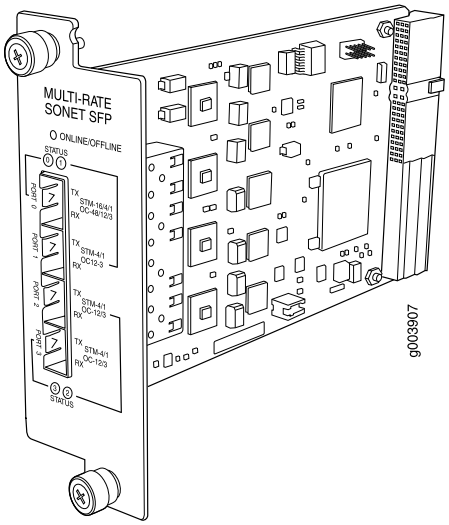


Figure 26: 4-Port SONET/SDH OC12/STM4 (Multi-Rate) PIC



Software release	• 1-port: Junos OS Release 8.4 and later (Type 1) • 4-port: Junos OS Release 8.3 and later (Type 2) For information on which FPCs support these PICs, see "PIC/FPC Compatibility (M40e Router)" on page 15.

Description	• 1-port: Rate-selectable using one of the following rates:
	  • 1-port OC3/STM1
	  • 1-port OC12/STM4
	  • 1-port OC12c/STM4c
	• 4-port: Rate-selectable using one of the following rates:
	  • 1-port OC12/STM4
	  • 1-port OC48/STM16
	  • 1-port OC48c/STM16c
	  • 4-port OC3c/STM1c
	  • 4-port OC12c/STM4c
	• Power requirement:
	  • 1-port: 0.20 A @ 48 V (9.5 W)
	  • 4-port: 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.
	• 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 (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*.

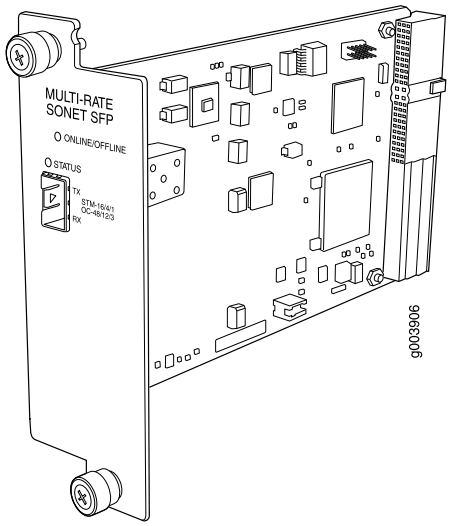
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

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 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

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

SONET/SDH OC48/STM16 (Multi-Rate) PIC with SFP (M40e Router)



Software release	• Junos OS Release 8.3 and later (Type 2) For information on which FPCs support this PIC, see “PIC/FPC Compatibility (M40e Router)” on page 15.

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.
	• 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:
	  • Multimode (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
	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*.

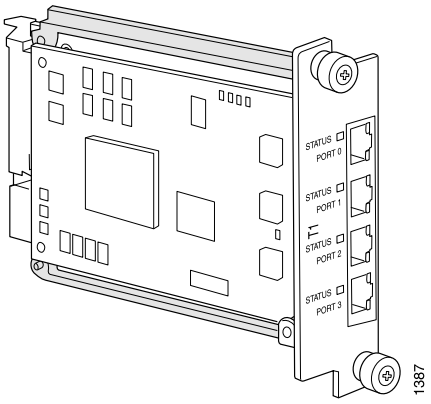
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

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

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

T1 PIC (M40e Router)



Software release	• Junos OS Release 5.2 and later For information on which FPCs support this PIC, see “PIC/FPC Compatibility (M40e Router)” on page 15.
Description	• Four T1 ports • Power requirement: 0.08 A @ 48 V (3.7 W) • Supports clear channel T1 per port (1.544 Mbps per channel) • Supports attenuation up to –12 dBm
Hardware features	• Per-port loop timing • Onboard DSU functionality for T1 connectivity

Software features	• ESF and SF framing
	• B8ZS and AMI coding
	• ESF CSU counters, WRT impairments, and CRC checking
	• Local DS1 line loopback, remote line loopback
	• Configurable clock source—internal or loop
	• Encapsulations:
	  ◦ High-Level Data Link Control (HDLC)
	  ◦ Frame Relay
	  ◦ Circuit cross-connect (CCC)
	  ◦ Point-to-Point Protocol (PPP)

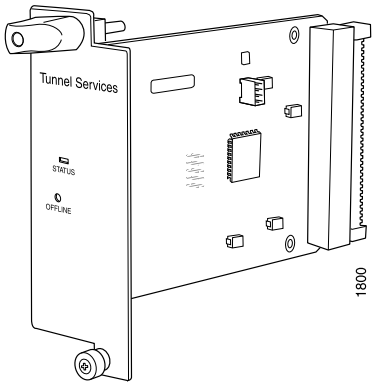
Cables and connectors	• 100-ohm RJ-48 connector
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events	• Alarm indication signal (AIS) • Bipolar violations • Excessive zeros • Far-end block errors (FEBE, E-bit errors) • Loss of frame (LOF) • Loss of signal (LOS) • Yellow alarm bit (X-bit) disagreements

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

Tunnel Services PIC (M40e Router)



Software release	• Junos OS Release 7.0 and later: Type 1 and Type 2 For information on which FPCs support this PIC, see “PIC/FPC Compatibility (M40e Router)” on page 15.
Description	• Power requirement: 0.07 A @ 48 V (3.4 W)
Hardware features	• Loopback function that encapsulates and de-encapsulates packets • OC48/STM16 tunneling bandwidth
Software features	For a list of the software features available for services PICs, see the *Junos OS Services Interfaces Configuration Guide*. • IP-IP unicast tunneling • GRE unicast tunneling • PIM sparse mode unicast tunneling
LEDs	One tricolor: • 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

Related Documentation

- M40e PICs Description on page 3
- High Availability Features (M40e Router) on page 5
- M40e PICs Supported on page 6

Junos OS Documentation and Release Notes

For a list of related Junos OS 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 OS 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

March 2011—Minor updates.

October 2010—Added connectors to the PICs supported tab. Updated links.

July 2010—Corporate rebranding.

May 2010—Added software features supported for the Circuit Emulation PICs. Updated the PIC combination limitations topic. Removed the 1-port Channelized OC12 IQ and 4-port DS3 EOL PICs .

January 2010—Added bulleted list and model numbers in the PICs Supported table.

August 2009—Updated SFP model numbers, changed router name, changed some formats.

10 April 2009—530-022507-01. Revision 10. Removed EOL Channelized E1 IQ PIC (PC-10CHE1-RJ48-QPP); added 10-port Channelized E1/T1 Enhanced IQ (IQE) PIC.

6 February 2009—530-022507-01. Revision 8. Added 4-port Channelized OC12/STM1 IQE PIC, 1-port Channelized OC48/STM16 IQE PIC, Gigabit Ethernet IQ2E PIC (4–port Type 1 and 8–port Type 2).

18 December 2008—530-022507-01. Revision 7. Added 4-port DS3/E3 IQE PIC and 4-port SONET/SDH OC3/STM1 IQE PIC.

30 November 2008—530-022507-01. Revision 6. Added 4-port Channelized DS3/E3 IQE PIC, 2-port Channelized OC3/STM1 IQE PIC, 1-port Channelized OC12/STM1 IQE PIC, 1-port OC12/STM1 IQE PIC, and Channelized E1 IQ PIC.

13 October 2008—530-022507-01. Revision 5. Added the Circuit Emulation PICs.

28 July 2008—530-022507-01. Revision 4. Removed EOL Adaptive Services II PIC. Removed EOL SONET/SDH OC3 and OC12 PICs.

18 April 2008—530-022507-01. Revision 3. Added flexible Ethernet encapsulation to the IQ PICs and IQ2 PICs.

1 February 2008—530-022507-01. Revision 2. Removed SONET/SDH OC3c/STM1 PIC (SMF-IR), SONET/SDH OC12c/STM4 PIC (SMF-IR), SONET/SDH OC12c/STM4 PIC (MM) and SONET/SDH OC48c/STM16 PIC with SFP.

19 October 2007—530-022507-01. Revision 1. Updated hardware features for the E1 PIC. Added first supported Junos OS Release for Services PICs features.

29 June 2007—530-020808-01. Revision 1. Added SONET/SDH OC3/STM1 and OC12c/STM4 (Multi-Rate) Type 1 PICs.

30 March 2007—530-020468-01. Revision 1. Removed Adaptive Services, Monitoring Services, and Multichannel DS3 PICs. Added SONET/SDH OC3 (Multi-Rate) PIC with SFP, SONET/SDH OC12 (Multi-Rate) PIC with SFP, and SONET/SDH OC48 (Multi-Rate) PIC with SFP.

12 January 2007—530-017888-01. Revision 1. Added optical diagnostic support for SONET/SDH OC48/STM16 PIC with SFP, 2-port and 4-port Gigabit Ethernet PIC with SFP. 1-port and 2-port Gigabit Ethernet IQ PIC with SFP, Gigabit Ethernet IQ2 PICs with SFP. Corrected LEDs for Gigabit Ethernet IQ2 PIC with SFP. Updated first supported release of 4-port Gigabit Ethernet IQ2 PICs from Junos OS Release 8.0 to Junos OS Release 7.6R2. Updated first supported release of Multiservices 400 PIC from Junos OS Release 8.1R1 to Junos OS Release 8.1R2. Removed product reclamation and recycling appendix.

13 October 2006—530-017179-01. Revision 1. Added Multiservices 100 PIC and Multiservices 400 PIC. Updated first supported release of 4-port Gigabit Ethernet IQ2 PICs from Junos OS Release 7.6R2 to Junos OS Release 8.0. Corrected maximum distance for 1000BASE-LH SFP transceivers.

28 June 2006—530-015868-01. Revision 2. Changed first supported Junos OS Release to 7.6R2 for 4-port Type 1 and 8-port Type 2 Ethernet IQ2 PICs. Corrected the illustration for the 12-port Fast Ethernet PIC. Updated contact information from product reclamation and recycling appendix. Corrected software features of 2-port and 4-port Gigabit Ethernet PICs.

13 April 2006—530-015868-01. Revision 1. Added Ethernet IQ2 PICs. Added product reclamation and recycling appendix.

9 January 2006—530-014164-01. Revision 2. Removed M5 and M10 router references to the Enhanced FPC.

14 September 2005—530-014164-01. Revision 1. Added Channelized 10-port T1 PIC.

13 June 2005—530-013672-01. Revision 1. Support for GRES has been added for the Adaptive Servies PIC and the Adaptive Services II PIC running Junos OS Release 7.3 or later. Added ATM2 IQ OC48 PIC.

05 April 2005—530-013301-01. Revision 1. Added Adaptive Services II FIPS PIC. Updated Tunnel Services PICs.

15 January 2005—530-012702-01. Revision 1. Removed Gigabit Ethernet PIC. Added Channelized OC3 IQ PIC. Added the PIC Feature Matrix table.

09 November 2004—Revision 3. Added 4-port Gigabit Ethernet PIC with SFP.

11 October 2004—Revision 2. Clarified description, hardware features, and counters for EIA-530 PIC.