M20 Internet Router

PIC Guide

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Part Number: 530-022506-01, Revision 1

This guide provides an overview and description of the Physical Interface Cards (PICs) supported by the Juniper Networks M20 Internet router. The PICs are described alphabetically. Table 1 on page 3 lists the PICs supported by the M20 Internet router by PIC family.

PICs provide the physical connection to various network media types. The PICs are mounted on Flexible PIC Concentrators (FPCs), which are inserted into a slot in a router. A PIC typically occupies a single slot on an FPC. PICs receive incoming packets from the network and transmit outgoing packets to the network. During this process, each PIC performs framing and high-speed signaling for its media type. Before transmitting outgoing data packets, the PICs encapsulate the packets received from the FPCs. Each PIC is equipped with a media-specific ASIC that performs control functions tailored to the PIC's media type. For complete information about installing PICs and transceivers, see the *PIC and Transceiver Installation Instructions* located at http://www.juniper.net/techpubs/.

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.

The M20 router supports the Type 1 FPCs listed in "FPCs Supported" on page 5. Table 3 on page 6 provides a PIC/FPC compatibility matrix for the current PICs supported by the M20 router.

For a complete list of end-of-life FPCs and end-of-life Enhanced FPCs for M-series and T-series routing platforms, see the *M-series and T-series Routing Platforms End-of-Life FPC Guide* located at http://www.juniper.net/techpubs/.

Table 1: PICs Supported in the M20 Internet Router

PIC Family and Type	Ports	First JUNOS Support	FPC Support	PIC Slots Required	Page
ATM2 IQ					
ATM2 DS3 IQ	4	6.1	Type 1	1 slot	13
ATM2 E3 IQ	4	6.1	Type 1	1 slot	15
ATM2 OC3/STM1 IQ	2	5.5	Type 1	1 slot	17
ATM2 OC12/STM4 IQ	1	5.5	Type 1	1 slot	20
Channelized					
Channelized OC12	1	4.0	Type 1	1 slot	28
Channelized IQ					
Channelized DS3 IQ	4	5.6	Type 1	1 slot	22
Channelized E1 IQ	10	5.6	Type 1	1 slot	24
Channelized OC3 IQ	1	7.1	Type 1	1 slot	26
Channelized OC12 IQ	1	5.6	Type 1	1 slot	30
Channelized STM1 IQ	1	5.7	Type 1	1 slot	32
Channelized T1 IQ	10	7.4	Type 1	1 slot	34
DS3, E1, and T1					
DS3	4	3.1	Type 1	1 slot	36
E1	4	4.1	Type 1	1 slot	38
T1	4	4.1	Type 1	1 slot	66
E3 IQ					
E3 IQ	4	6.1	Type 1	1 slot	40
Ethernet					
Fast Ethernet	4	4.1	Type 1	1 slot	46
Fast Ethernet	8	5.2	Type 1	1 slot	46
Fast Ethernet	12	5.1	Type 1	1 slot	46
Gigabit Ethernet with SFP	1	6.3	Type 1	1 slot	49
Ethernet IQ					
Gigabit Ethernet IQ with SFP	1	6.0	Type 1	1 slot	51
Ethernet IQ2					

Table 1: PICs Supported in the M20 Internet Router *(continued)*

PIC Family and Type	Ports	First JUNOS Support	FPC Support	PIC Slots Required	Page
Gigabit Ethernet IQ2 with SFP	4	7.6R3	Type 1	1 slot	53
Services					
Adaptive Services II	0	6.4	Type 1	1 slot	8
Adaptive Services II Layer 2 Services	0	7.5	Type 1	1 slot	10
ES	0	5.2	Type 1	1 slot	44
Link Services	0	5.6	Type 1	1 slot	56
Tunnel Services	0	3.3	Type 1	1 slot	67
Serial					
EIA-530	2	5.6	Type 1	1 slot	42
SONET/SDH					
SONET/SDH OC3c/STM1	4	3.1	Type 1	1 slot	57
SONET/SDH OC12c/STM4	1	3.1	Type 1	1 slot	60
SONET/SDH OC48c/STM16 with SFP	1	6.1	Type 1	Entire FPC slot	63

FPCs Supported

The M20 router supports the Type 1 FPCs listed in Table 2 on page 5. 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 M20 Router

FPC Name	FPC Model Number	Maximum Number of PICs Supported per FPC	Maximum Throughput per FPC	First JUNOS Release
Enhanced Plus FPC1	M20-FPC1-EP	4	3.2 Gbps	7.2

PIC/FPC Compatibility

Table 3 on page 6 provides a PIC/FPC compatibility matrix for the current PICs supported by the M20 router. The table lists the first JUNOS release in which the FPC supports the PIC. For example, JUNOS 7.2 is the first release in which the M20-FPC1-EP supports the ATM2 OC3/STM1 IQ, 2-port PIC.

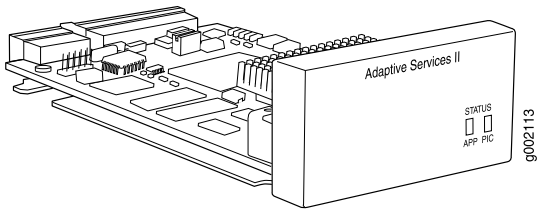
Table 3: M20 PIC/FPC Compatibility

PIC Type	Number of Ports	M20-FPC1-EP
ATM2 IQ PICs		
ATM2 DS3 IQ	4	7.2
ATM2 E3 IQ	4	7.2
ATM2 OC3/STM1 IQ	2	7.2
ATM2 OC12/STM4 IQ	1	7.2
Channelized PICs		
ChOC12	1	7.2
Channelized IQ PICs		
ChDS3 IQ	4	7.2
ChE1 IQ	10	7.2
ChOC3 IQ	1	7.2
ChOC12 IQ	1	7.2
ChSTM1 IQ	1	7.2
ChT1 IQ	10	7.2
T1, DS3, E1, E3 PICs		
DS3	4	7.2
E1	4	7.2
T1	4	7.2
E3 IQ PIC		
E3 IQ	4	7.2
Ethernet PICs		
Fast Ethernet	4	7.2
Fast Ethernet	8	7.2
Fast Ethernet	12	7.2

Table 3: M20 PIC/FPC Compatibility *(continued)*

PIC Type	Number of Ports	M20-FPC1-EP
Gigabit Ethernet, SFP	1	7.2
Ethernet IQ PICs		
Gigabit Ethernet IQ, SFP	1	7.2
Ethernet IQ2 PICs		
Gigabit Ethernet IQ2, SFP	4	7.6R3
Services PICs		
Adaptive Services II	0	7.2
Adaptive Services II (AS) Layer 2 Services	0	7.5
ES	0	7.2
Link Services	0	7.2
Tunnel Services	0	7.2
SONET/SDH PICs		
OC3c/STM1	4	7.2
OC12c/STM4	1	7.2
OC48c/STM16, SFP	1	7.2

Adaptive Services II PIC



Software release	■ JUNOS 6.4 and later
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: 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	Depending on your JUNOS release and individual licenses, software features for this PIC can include the features listed in Table 4 on page 8. For more information about the software features available for services PICs, see the *JUNOS 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. ■ Amber—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. ■ Amber—Service is overloaded.

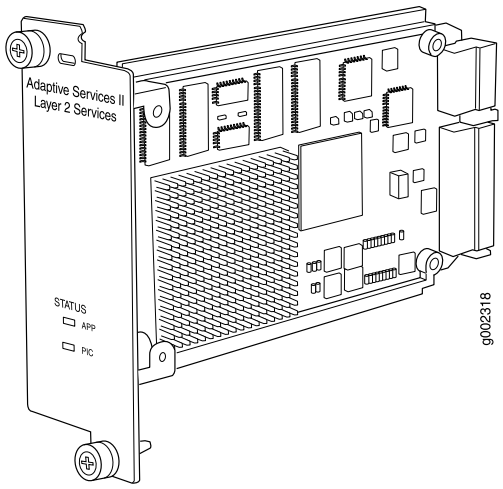
Table 4: Adaptive Services PICs Software Features

Software Feature	Adaptive Services II PIC	Adaptive Services II Layer 2 Services PIC
GRE Key	–	–
GRE dont-fragment	–	–

Table 4: Adaptive Services PICs Software Features *(continued)*

Stateful firewall with packet inspection: detects SYN attacks, ICMP and UDP floods, and ping of death attacks	6.4	–
Network Address Translation (NAT) for IP addresses	6.4	–
Port Address Translation (PAT) for port numbers	6.4	–
IP Security (IPSec) encryption	6.4	–
Active flow monitoring exports cflowd version 5 and version 8 records	7.0	–
Active flow monitoring exports version 9 records, based on RFC 3954 (IP v4 templates only)	8.3	–
Passive flow monitoring	–	–
Passive flow collection	–	–
Flow-tap	8.1	–
Dynamic flow capture	–	–
Real-time performance monitoring	8.3	–
Link services	7.3	7.5
Tunnel services: ■ IP-IP unicast tunneling ■ GRE unicast tunneling—Supports GRE fragmentation ■ Protocol Independent Multicast (PIM) sparse mode unicast tunneling	6.4	7.5
Virtual tunnel interface for Layer 3 VPNs	6.4	–
Layer 2 Tunneling Protocol (L2TP)	–	–
Voice services: ■ Compressed Real-Time Transport Protocol (CRTP)	7.3	7.5
Encapsulations: ■ Multilink Frame Relay (MLFR) ■ Multilink Point-to-Point Protocol (MLPP)	6.4	–

Adaptive Services II Layer 2 Services PIC



Software release	■ JUNOS 7.5 and later
Description	■ Supports Layer 2 Service package only. Tunnel services are included with the PIC. Other services require an individual license. ■ Power requirement: 0.4 A @ 48 V (19 W)
Hardware features	■ Support for up to 2000 service sets ■ Support for MTUs up to 9192 bytes for Gigabit Ethernet and SONET interfaces
Software features	Depending on your JUNOS release and individual licenses, software features for this PIC can include the features listed in Table 5 on page 11. For more information about the software features available for services PICs, see the *JUNOS 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. ■ Amber—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. ■ Amber—Service is overloaded.

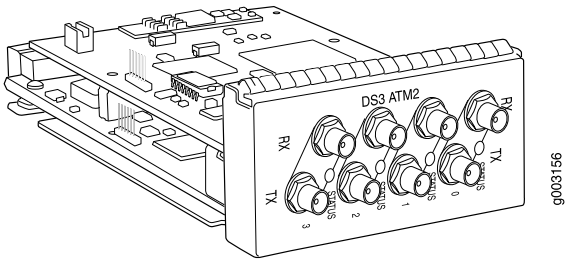
Table 5: Adaptive Services PiCs Software Features

Software Feature	Adaptive Services II PIC	Adaptive Services II Layer 2 Services PIC
GRE Key	–	–
GRE dont-fragment	–	–
Stateful firewall with packet inspection: detects SYN attacks, ICMP and UDP floods, and ping of death attacks	6.4	–
Network Address Translation (NAT) for IP addresses	6.4	–
Port Address Translation (PAT) for port numbers	6.4	–
IP Security (IPSec) encryption	6.4	–
Active flow monitoring exports cflowd version 5 and version 8 records	7.0	–
Active flow monitoring exports version 9 records, based on RFC 3954 (IP v4 templates only)	8.3	–
Passive flow monitoring	–	–
Passive flow collection	–	–
Flow-tap	8.1	–
Dynamic flow capture	–	–
Real-time performance monitoring	8.3	–
Link services	7.3	7.5
Tunnel services: ■ IP-IP unicast tunneling ■ GRE unicast tunneling—Supports GRE fragmentation ■ Protocol Independent Multicast (PIM) sparse mode unicast tunneling	6.4	7.5
Virtual tunnel interface for Layer 3 VPNs	6.4	–
Layer 2 Tunneling Protocol (L2TP)	–	–
Voice services: ■ Compressed Real-Time Transport Protocol (CRTP)	7.3	7.5

Table 5: Adaptive Services PiCs Software Features *(continued)*

Encapsulations: ■ Multilink Frame Relay (MLFR) ■ Multilink Point-to-Point Protocol (MLPP)	6.4	–

ATM2 DS3 IQ PIC



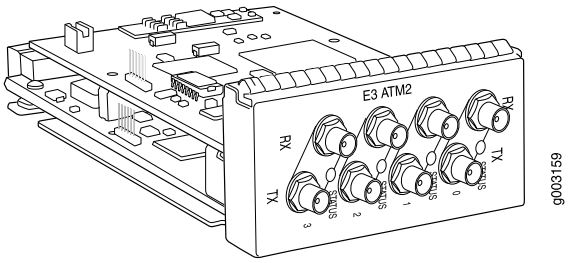
Software release	■ JUNOS 6.1 and later
Description	■ Four DS3 ports ■ Power requirement: 0.41 A @ 48 V (20.0 W) ■ Intelligent queuing (IQ) PICs support fine-grained queuing per logical interface. ■ ATM standards compliant

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 ■ Amber—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

ATM2 E3 IQ PIC



Software release	■ JUNOS 6.1 and later
Description	■ Four E3 ports ■ Power requirement: 0.41 A @ 48 V (20 W) ■ Intelligent queuing (IQ) PICs support fine-grained queuing per logical interface ■ ATM standards compliant

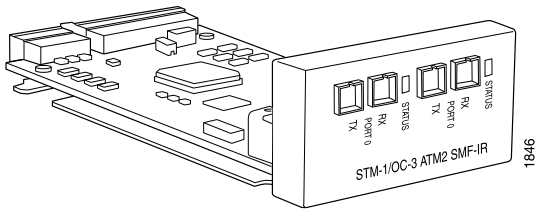
Hardware features	■ 16-MB SDRAM memory for ATM segmentation and reassembly (SAR)
	■ ATM switch ID
	■ Configurable framing options:
	  ■ G.751 direct mapping
	  ■ G.751 with PLCP encapsulation (default)
	  ■ G.832 ATM direct mapping
	■ Internal and loop timing

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 ■ Amber—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

ATM2 OC3/STM1 IQ PIC



Software release	■ JUNOS 5.5 and later
Description	■ Two OC3 ports ■ Power requirement: 0.41 A @ 48 V (20 W) ■ Intelligent queuing (IQ) PICs support 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 indicator (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) ■ Optical interface support—See Table 6 on page 18
LEDs	One tricolor per port: ■ Off—Not enabled ■ Green—Online with no alarms or failures ■ Amber—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 errored seconds (ES-LFE, ES-PFE), far-end severely errored seconds (SES-LFE, SES-PFE), far-end unavailable seconds (UAS-LFE, UAS-PFE) ■ Loss of cell delineation (LOC), loss of frame (LOF), loss of pointer (LOP-P), loss of signal (LOS) ■ Payload mismatch (PLM-P), payload unequipped (UNEQ-P) ■ 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)

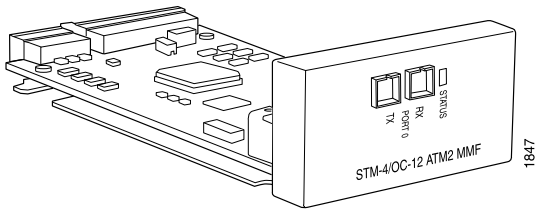
Table 6: Optical Interface Support for ATM2 OC3 IQ PICs

Parameter	Intermediate Reach (IR)	Multimode
Optical interface	Single-mode	Multimode
Transceiver type	Fixed	Fixed

Table 6: Optical Interface Support for ATM2 OC3 IQ PICs *(continued)*

Parameter	Intermediate Reach (IR)	Multimode
Standard	Telcordia GR-253	Multivendor agreement
Maximum distance	9.3 miles/15 km	1.2 miles/2 km
Transmitter wavelength	1260 through 1360 nm	1270 through 1380 nm
Average launch power	–15 through –8 dBm	–20 through –14 dBm
Receiver saturation	–8 dBm	–14 dBm
Receiver sensitivity	–28 dBm	–30 dBm

ATM2 OC12/STM4 IQ PIC



Software release	■ JUNOS 5.5 and later
Description	■ One OC12 port ■ Power requirements: 0.41 A/48 V @ 20 W ■ Intelligent queuing (IQ) PICs support 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	■ 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

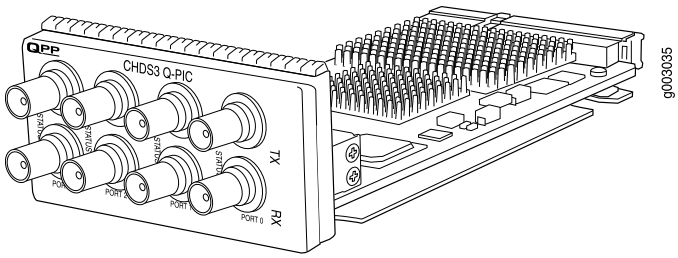
Software features	■ Circuit cross-connect for leveraging ATM access networks
	■ User-configurable virtual circuit (VC) and virtual path (VP) support
	■ Support for idle cell or unassigned cell transmission
	■ OAM fault management processes alarm indication signal (AIS), remote defect indication (RDI), 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) ■ Optical interface support—See Table 7 on page 21
LEDs	One tricolor per port: ■ Off—Not enabled ■ Green—Online with no alarms or failures ■ Amber—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 errored seconds (ES-LFE, ES-PFE), far-end severely errored seconds (SES-LFE, SES-PFE), far-end unavailable seconds (UAS-LFE, UAS-PFE) ■ Loss of cell delineation (LOC), loss of frame (LOF), loss of pointer (LOP-P), loss of signal (LOS) ■ Payload mismatch (PLM-P), payload unequipped (UNEQ-P) ■ 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)

Table 7: Optical Interface Support for ATM2 OC12/STM4 IQ PICs

Parameter	Intermediate Reach (IR) Transceiver	Multimode Transceiver
Optical interface	Single-mode	Multimode
Transceiver type	Fixed	Fixed
Standard	Telcordia GR-253	Multivendor agreement
Maximum distance	9.3 miles/15 km	546.8 yards/500 m
Transmitter wavelength	1274 through 1356 nm	1270 through 1380 nm
Average launch power	–15 through –8 dBm	–20 through –14 dBm
Receiver saturation	–8 dBm	–14 dBm
Receiver sensitivity	–28 dBm	–26 dBm

Channelized DS3 IQ PIC



Software release	■ JUNOS 5.6 and later
Description	■ Four DS3 ports ■ Power requirement: 0.32 A @ 48 V (15.6 W) ■ Intelligent queuing (IQ) PICs support fine-grained queuing per logical interface ■ Channelization: DS3, DS0

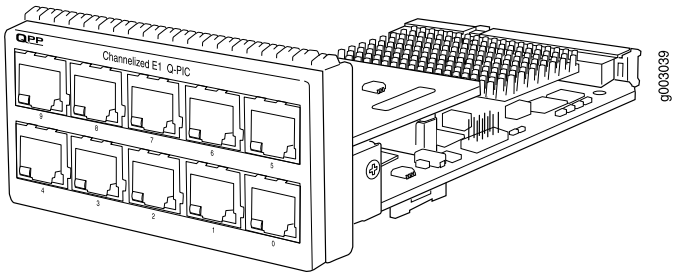
Hardware features	■ Data service unit (DSU) functionality
	■ Subrate and scrambling:
	  ■ Digital Link/Quick Eagle
	  ■ Kentrox
	  ■ Larscom
	  ■ ADTRAN
	  ■ Verilink
	■ B3ZS line encoding
	■ M13 or C-bit parity
	■ Full bit error rate test (BERT)
	■ Local and remote loopback testing

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:
	  ■ High-Level Data Link Control (HDLC)
	  ■ Frame Relay
	  ■ Circuit cross-connect (CCC)
	  ■ Translational cross-connect (TCC)
	  ■ 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 ■ Amber—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

Channelized E1 IQ PIC



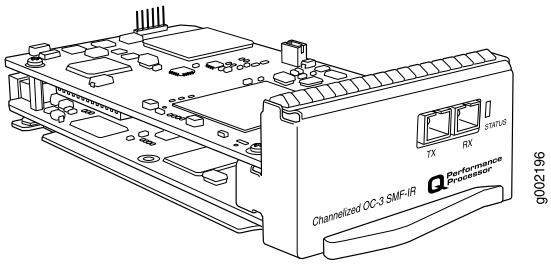
Software release	■ JUNOS 5.6 and later
Description	■ Ten E1 ports ■ Power requirement: 0.15 A @ 48 V (7.2 W) ■ Intelligent queuing (IQ) PICs support fine-grained queuing per logical interface. ■ Channelization: E1, DS0
Hardware features	■ Data service unit (DSU) functionality ■ Ports configurable as 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:
	  ■ 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
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

Channelized OC3 IQ PIC



Software release	■ JUNOS 7.6 and later
Description	■ One OC3 port ■ Power requirement: 0.39 A @ 48 V (18.6 W) ■ Intelligent queuing (IQ) PICs support 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:
	  ■ High-Level Data Link Control (HDLC)
	  ■ Frame Relay
	  ■ Circuit cross-connect (CCC)
	  ■ Translational cross-connect (TCC)
	  ■ Point-to-Point Protocol (PPP)

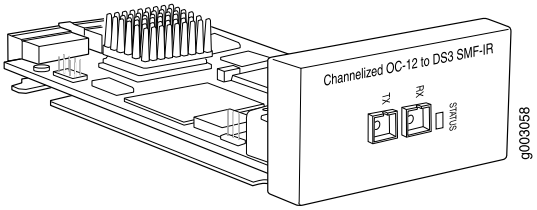
Cables and connectors	■ Duplex SC/PC connector (Rx and Tx); single-mode fiber intermediate-reach fiber ■ Optical interface support—See Table 8 on page 27

LEDs	One tricolor per port: ■ Off—Not enabled ■ Green—Online with no alarms or failures ■ Amber—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

Table 8: Optical Interface Support for Channelized OC3 IQ PICs

PIC Type	Single-Mode Intermediate Reach
Optical interface	Single-mode, intermediate reach
Standard	Telcordia GR-253 compliant
Maximum Distance	9.3 miles/15 km
Wavelength	1274 through 1356 nm
Average launch power	–15 through –8 dBm
Receiver saturation	–8 dBm
Receiver sensitivity	–28 dBm

Channelized OC12 PIC



Software release	■ JUNOS 4.0 and later
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:
	  ■ High-Level Data Link Control (HDLC)
	  ■ Frame Relay
	  ■ Circuit cross-connect (CCC)
	  ■ Translational cross-connect (TCC)
	  ■ Point-to-Point Protocol (PPP)

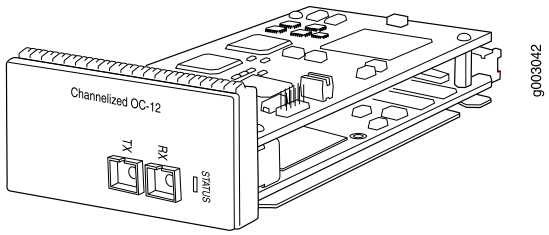
Cables and connectors	■ Duplex SC/PC connector (RX and TX) ■ Optical interface support—See Table 9 on page 29
LEDs	One tricolor per port: ■ Off—Not enabled ■ Green—Online with no alarms or failures ■ Amber—Online with alarms for remote failures ■ Red—Active with a local alarm; router has detected a failure

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

Table 9: Optical Interface Support for Channelized OC12 PICs

Optical Parameter	Single-Mode Intermediate Reach
Optical interface	Single-mode transmitter
Standard	Telcordia GR-253 compliant
Maximum distance	Single-mode cable: 9.3 miles/15 km
Wavelength	1274 through 1356 nm
Average launch power	–15 through –8 dBm
Receiver saturation	–8 dBm
Receiver sensitivity	–28 dBm

Channelized OC12 IQ PIC



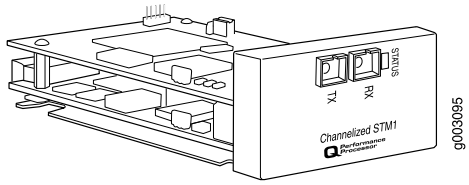
Software release	■ JUNOS 5.6 and later
Description	■ One OC12 port ■ Power requirement: 0.23 A @ 48 V (10.8 W) ■ Intelligent queuing (IQ) PICs support fine-grained queuing per logical interface ■ Channelization: OC3, DS3, DS1, DS0
Hardware features	■ Subrate and scrambling: ■ Digital Link/Quick Eagle ■ 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: ■ 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 fiber ■ Optical interface support—See Table 10 on page 31

LEDs	One tricolor per port: ■ Off—Not enabled ■ Green—Online with no alarms or failures ■ Amber—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 (CV-S, CV-L, CV-P) ■ 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
Instrumentation (counters)	■ Layer 2 per-queue and per-channel packet and byte counters

Table 10: Optical Interface Support for Channelized OC12 IQ PICs

Parameter	Intermediate Reach (IR)
Optical interface	Single-mode
Standard	Telcordia GR-253
Maximum distance	9.3 miles/15 km
Transmitter wavelength	1274 through 1356 nm
Average launch power	–15 through –8 dBm
Receiver saturation	–8 dBm
Receiver sensitivity	–28 dBm

Channelized STM1 IQ PIC



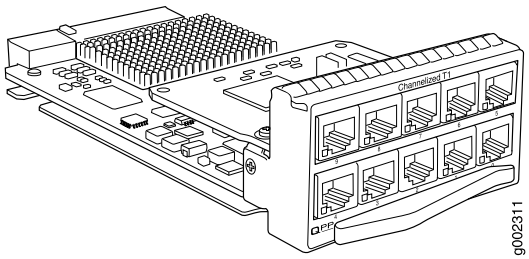
Software release	■ JUNOS 5.7 and later
Description	■ One STM1 port ■ Power requirement: 0.39 A @ 48 V (18.6 W) ■ Intelligent queuing (IQ) PICs support fine-grained queuing per logical interface ■ Channelization: STM1c, fractional E1, framed and unframed DS0
Hardware features	■ Packet buffering, Layer 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 ■ Amber—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 (CV-S, CV-L, CV-P) ■ Errored seconds (ES-S, ES-L, ES-P), far-end bit errors REI-L, REI-P (CV-LFE, 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) ■ Loss of frame (LOF), loss of pointer (LOP-P), loss of signal (LOS) ■ Payload mismatch (PLM-P), payload unequipped (UNEQ-P) ■ 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)
Instrumentation (counters)	■ Layer 2 per-queue and per-channel packet and byte counters

Channelized T1 IQ PIC



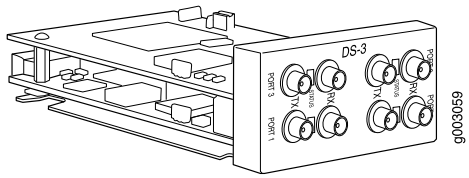
Software release	■ JUNOS 7.4 and later
Description	■ Ten T1 ports ■ Power requirement: 0.15 A @ 48 V (7.2 W) ■ Intelligent queuing (IQ) PICs support fine-grained queuing per logical interface. ■ Channelization: T1, FT1, *N*xDS0

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 ■ Amber—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) ■ Remote defect indication (RDI) ■ Loss of frame (LOF) ■ Loss of signal (LOS) ■ Bipolar violation (BPV) ■ Excessive zero (EXZ) ■ Line code violation (LCV) ■ 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

DS3 PIC



Software release	■ JUNOS 3.1 and later
Description	■ Four DS3 ports ■ Power requirement: 0.47 A @ 48 V (22.5 W) ■ Integrated DSU interoperability with leading DSU vendors

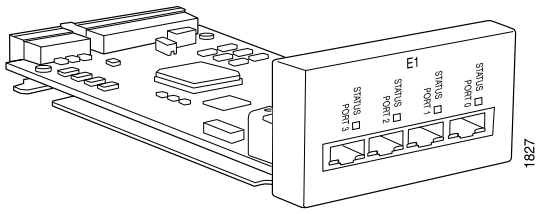
Hardware features	■ High-performance throughput on each port at speeds up to 44.736 Mbps, full duplex
	■ C-bit framing
	■ B3ZS line encoding
	■ Subrate and scrambling:
	  ■ Digital Link
	  ■ Kentrox
	  ■ Larscom
	■ Per-port rate policing on input
	■ Per-port rate shaping on output
	■ Packet buffering, Layer 2 parsing

Software features	■ DS3 functionality:
	  ■ C-bit framing
	  ■ B3ZS line encoding
	■ DS3 diagnostics and loopback control
	■ DS3 alarm and event counting and detection
	■ Per-packet counts and byte counts
	■ Local and remote loopback testing, as well as BERT testing per DS3
	■ DS3 far-end alarm and control (FEAC) channel support
	■ Encapsulations:
	  ■ High-Level Data Link Control (HDLC)
	  ■ Frame Relay
	  ■ Circuit cross-connect (CCC)
	  ■ Point-to-Point Protocol (PPP)

Cables and connectors	■ Custom 10-ft (3.05-m) posilock SMB to BNC male cable, separate Rx and Tx (provided)

LEDs	One tricolor per port: ■ Off—Not enabled ■ Green—Online with no alarms or failures ■ Amber—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) ■ Bit error rate test (BERT) functionality on PIC (you can configure one DS3 channel in BERT mode and configure the remaining channels to transmit and receive normal traffic) ■ Equipment failure (does not affect service) ■ Far-end block error (FEBE) ■ Frame error ■ Idle code, Idle received ■ Local and remote loopback ■ Loss of signal (LOS) ■ Out of frame (OOF) ■ Parity bit (P-bit) disagreements ■ Path parity error ■ Yellow alarm bit (X-bit) disagreements

E1 PIC



Software release	■ JUNOS 4.1 and later

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

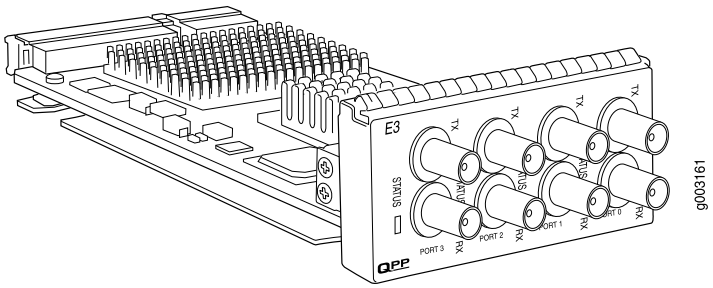
Hardware features	■ High-performance throughput on each port at speeds up to 2.048 Mbps, full duplex ■ Maximum transmission units (MTUs) of up to 4500 bytes ■ Per-interface diagnostics and loopback control ■ Per-interface shaping on output ■ Per-interface alarm and event counting and detection ■ HDB3 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 ■ Amber—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

E3 IQ PIC



Software release	■ JUNOS 6.1 and later
Description	■ Four E3 ports ■ Power requirement: 0.38 A @ 48 V (18 W) ■ Intelligent queuing (IQ) PICs support fine-grained queuing per logical interface

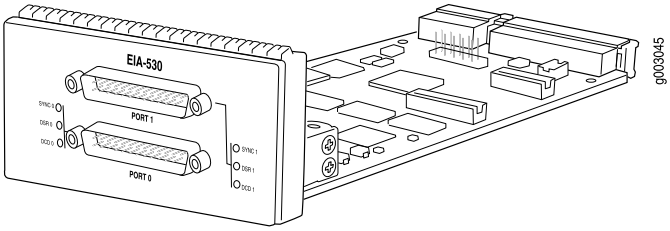
Hardware features	■ Clear-channel (34.368-Mbps) and subrate E3
	■ Unframed or ITU G.751 framing
	■ Data service unit (DSU) functionality
	■ Subrate and scrambling:
	  ■ Digital Link/Quick Eagle
	  ■ Kentrox
	■ HDB3 line encoding
	■ Full bit error rate test (BERT)
	■ Local and remote loopback testing

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 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 ■ Amber—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

EIA-530 PIC



Software release	■ JUNOS 5.6 and later
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

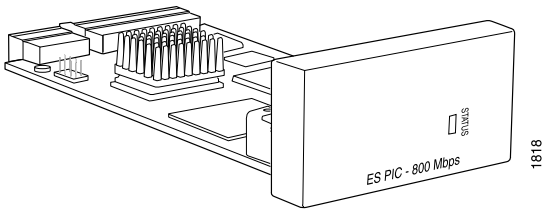
Software features	■ Supports four queues per port
	■ Random early detection (RED)
	■ Transmitter Signal Element Timing is looped from the timing received on the Transmitted Signal Element DCE. EIA-530 ports support the ability to invert the Transmit Data Element. The EIA-530 ports support the following 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:
	  ■ High-Level Data Link Control (HDLC)
	  ■ Frame Relay
	  ■ Circuit cross-connect (CCC)
	  ■ Translational cross-connect (TCC)
	  ■ 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

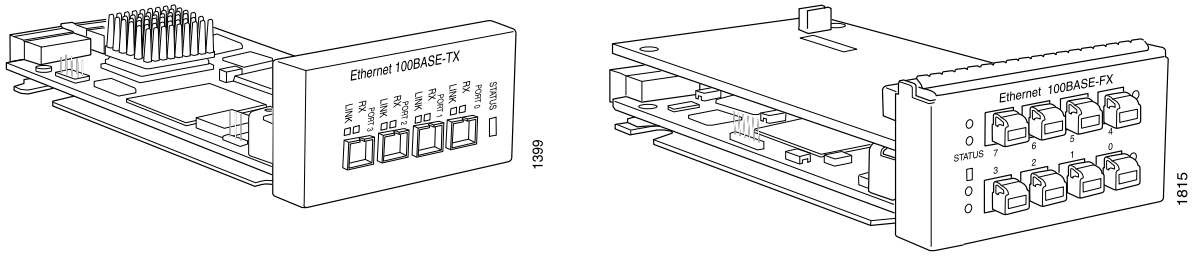
ES PIC



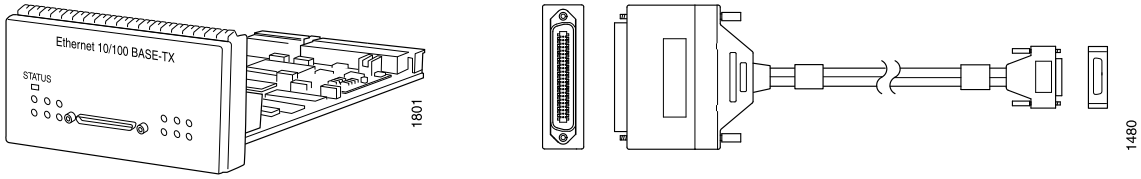
Software release	■ JUNOS 5.2 and later
Description	■ High-bandwidth encryption (in accordance with IPSec standards) ■ Power requirement: 0.21 A @ 48 V (10 W) ■ Support for IPSec encryption, decryption, and key calculation acceleration **NOTE:** The ES PIC does not support reassembly and decryption of 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 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 pre-shared 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 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 ■ Amber—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 anti-reply failures ■ Total encryption ASIC errors per PIC

Fast Ethernet PICs



Left: 4-Port Fast Ethernet PIC; Right: 8-Port Fast Ethernet PIC



Left: 12-Port Fast Ethernet PIC; Right: VHDCI to RJ-21 Cable

Software release	■ 4-port: JUNOS 4.1 and later ■ 8-port: JUNOS 5.2 and later ■ 12-port: JUNOS 5.1 and later

Description	■ 4 or 12 100Base-TX ports; 8 100Base-FX 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)

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 support MTUs of up to 9192 bytes; 8-port and 12-port PICs support MTUs of up to 1532 bytes ■ 4-port PICs support 1024 802.1Q VLANs per port; 8-port and 12-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 Table 11 on page 48

12-port PIC:

- Connector: One very High Density Connector Interface (VHDCI) to RJ-21 cable that connects to an RJ-45 patch panel

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:

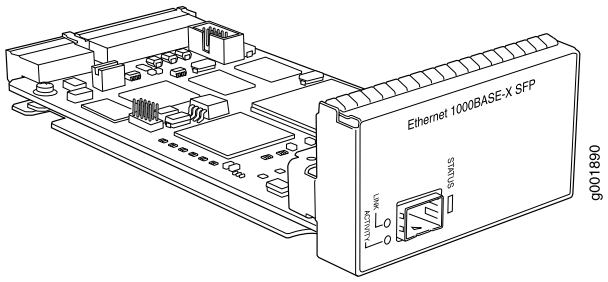
- Green—100-Mbps link established
- Flashing green—100-Mbps activity
- Yellow—10-Mbps link established
- Flashing yellow—10-Mbps activity
- Off—No link present

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

Table 11: Optical Interface Support for Fast Ethernet PICs

Optical Parameters	FX interface for 8-port
Optical interface	Multimode
Maximum distance	62.5/125 micrometer MMF: 1.24 miles/2 km
Wavelength	1,270 to 1,380 nm
Average launch power	–20 to –14 dBm
Receiver saturation	–14 dBm
Receiver sensitivity	–34 dBm

Gigabit Ethernet PIC with SFP



Software release	■ JUNOS 6.3 and later
Description	■ One Gigabit Ethernet port ■ Power requirements: 0.15 A/48 V @ 7.3 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 ■ Flexible Ethernet encapsulation ■ Multiple tag protocol identifiers (TPID) support ■ Source MAC learning ■ MAC accounting and policing—Dynamic local address learning of source MAC addresses

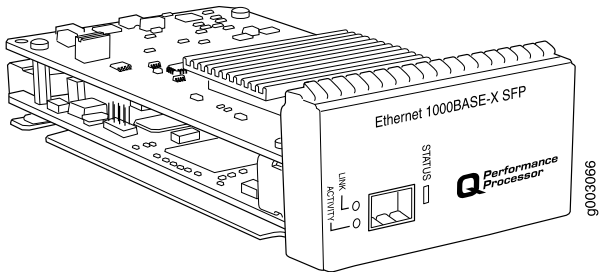
Cables and connectors	■ You can install any transceiver supported by the PIC. For information about installing and removing transceivers, see the *PIC and Transceiver Installation Instructions*.
	■ SX, LX, and LH SFP transceivers:
	  ■ Duplex LC/PC connector (Rx and Tx)
	  ■ Optical interface support—See Table 12 on page 50
	■ 1000Base-T SFP transceivers:
	  ■ Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
	  ■ Pinout: MDI crossover
	  ■ Length: 328 ft/100 m
	
	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

Table 12: Optical Interface Support for Gigabit Ethernet PICs with SFP

Parameter	1000Base-SX	1000Base-LX	1000Base-LH
Optical interface	Multimode	Single-mode	Single-mode
Transceiver type	SFP	SFP	SFP
Maximum distance	62.5/125 MMF cable: 656 ft/200 m	9/125 SMF cable: 6.2 miles/10 km	9/125 SMF cable: 43.5 miles/70 km
	50/125 MMF cable: 1640 ft/500 m	62.5/125 and 50/125 MMF cable: 1804.5 ft/550 m	
Transmitter wavelength	770 through 860 nm	1270 through 1355 nm	1355 through 1580 nm
Average launch power	–9.5 through 0 dBm	–11.5 through –3 dBm	–3 through +3 dBm
Average receive power	–17 through 0 dBm	–19 through –3 dBm	–23 through 1580 dBm
Receiver saturation	0 dBm	–3 dBm	–3 dBm
Receiver sensitivity	–17 dBm	–19 dBm	–23 dBm

Gigabit Ethernet IQ PIC with SFP



Software release	■ JUNOS 6.0 and later
Description	■ One Gigabit Ethernet port ■ Power requirement: 0.46 A @ 48 V (22 W) ■ Intelligent queuing (IQ) PICs support fine-grained queuing per-logical interface.
Hardware features	■ High-performance throughput at speeds up to 1 Gbps ■ Full-duplex mode ■ Large MTUs of up to 9192 bytes
Software features	■ Optical diagnostics and related alarms (JUNOS Release 8.2 and later) ■ Quality of service (QoS) per channel: Weighted round-robin (WRR), Random early drop (RED), Weighted random early drop (WRED) ■ Virtual Router Redundancy Protocol (VRRP) support ■ 802.1Q Virtual LANs ■ VLAN stacking and rewriting ■ MAC policing, accounting, and filters ■ JUNOS Release 7.0 or later is required to configure graceful Routing Engine switchover (GRES).

Cables and connectors	■ The Gigabit Ethernet IQ PICs use small form factor-pluggables (SFPs) that allow different interfaces to be used on the PIC. For information about installing and removing SFPs, see the *M20 Internet Router Hardware Guide*.
	■ SX, LX, and LH SFPs:
	  ■ Duplex LC/PC connector (RX and TX)
	  ■ Optical interface support—See Table 13 on page 52
	■ 1000Base-T SFPs:
	  ■ Connector: Four-pair, Category 5 shielded twisted pair connectivity through an RJ-45 connector
	  ■ Pinout: MDI crossover
	  ■ Length: 328 ft/100 m

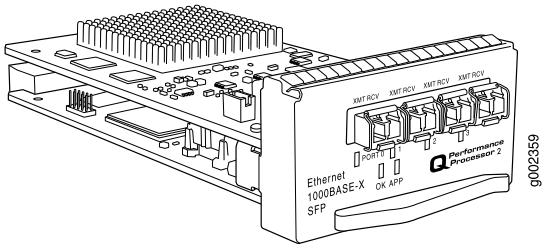
LEDs

- Status LEDs, one tricolor:
  - Off—Not enabled
  - Green—Online with no alarms or failures
  - Amber—Online with alarms for remote failures
  - Red—Active with a local alarm; router has detected a failure
- Port LEDs, one per port:
  - Off—Port is down
  - Green—Link is established

Table 13: Optical Interface Support for Gigabit Ethernet IQ PICs with SFP

Parameter	1000Base-SX	1000Base-LX	1000Base-LH
Optical interface	Multimode	Single-mode	Single-mode
Transceiver type	SFP	SFP	SFP
Standard	IEEE 802.3—1998	IEEE 802.3—1998	Multivendor agreement
Maximum distance	62.5/125 MMF cable: 656 ft/200 m	9/125 SMF cable: 6.2 miles/10 km	9/125 SMF cable: 43.5 miles/70 km
	50/125 MMF cable: 1640 ft/500 m	62.5/125 or 50/125 MMF cable: 1804.5 ft/550 m	
Transmitter wavelength	770 through 860 nm	1270 through 1355 nm	1480 through 1580 nm
Average launch power	–9.5 through 0 dBm	–11.5 through –3 dBm	–3 through +3 dBm
Average receive power	–17 through 0 dBM	–19 through –3 dBM	–20 through –3 dBM
Receiver saturation	0 dBm	–3 dBm	–3 dBm
Receiver sensitivity	–17dBm	–19 dBm	–23 dBm

Gigabit Ethernet IQ2 PIC with SFP



Software release	■ JUNOS 7.6R3 and later
Description	■ Four Gigabit Ethernet ports ■ Power requirement: 0.65 A @ 48 V (31 W)
Hardware features	■ High-performance throughput on each port: speeds up to 1 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 ■ MAC learning, policing, accounting, and filtering

Cables and connectors

- You can install any transceiver supported by the PIC. For information about installing and removing transceivers, see the *PIC and Transceiver Installation Instructions*.

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

- Fiber-optic SX, LX, and LH small form-factor pluggable transceivers (SFPs):
  - Connector: Duplex LC/PC (Rx and Tx)
  - Optical interface support—See Table 14 on page 54
- Copper 1000Base-T SFPs:
  - Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
  - Pinout: MDI crossover
  - Length: 328 ft/100 m

LEDs

OK LED, one tricolor:

- Off—PIC is offline and it is safe to remove it from the router.
- Green—PIC is operating normally.
- Amber—PIC is initializing.
- Red—PIC has an error or failure.

APP LED, one:

- 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.

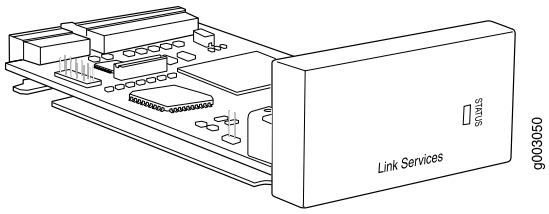
Table 14: Optical Interface Support for Gigabit Ethernet IQ2 PICs with SFP

Parameter	1000Base-SX	1000Base-LX	1000Base-LH
Optical interface	Multimode	Single-mode	Single-mode
Transceiver type	SFP	SFP	SFP
Standard	IEEE 802.3—1998	IEEE 802.3—1998	Multivendor agreement
Maximum distance	62.5/125 MMF cable: 656 ft/200 m	9/125 SMF cable: 6.2 miles/10 km	9/125 SMF cable: 43.5 miles/70 km
	50/125 MMF cable: 1640 ft/500 m	62.5/125 or 50/125 MMF cable: 1804.5 ft/550 m	
Transmitter wavelength	770 through 860 nm	1270 through 1355 nm	1480 through 1580 nm

Table 14: Optical Interface Support for Gigabit Ethernet IQ2 PICs with SFP *(continued)*

Parameter	1000Base-SX	1000Base-LX	1000Base-LH
Average launch power	–9.5 through 0 dBm	–11.5 through –3 dBm	–3 through +3 dBm
Average receive power	–17 through 0 dBM	–19 through –3 dBM	–20 through –3 dBM
Receiver saturation	0 dBm	–3 dBm	–3 dBm
Receiver sensitivity	–17dBm	–19 dBm	–23 dBm

Link Services PIC



Software release	■ JUNOS 5.6 and later

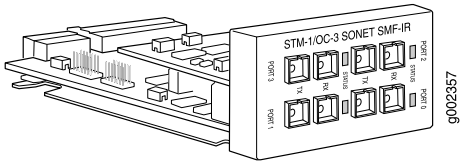
Description	■ Power requirement: 0.17 A @ 48 V (8 W)
	■ Three versions:
	  ■ 4 multilink bundles, 256 LFI links
	  ■ 32 multilink bundles, 256 LFI links
	  ■ 128 multilink bundles, 256 LFI links
	■ Multilink bonding, link fragmentation and interleaving (LFI), and tunneling

Hardware features	■ Rate limiting/policing per multilink bundle ■ Byte-wise load balancing across multilink bundles ■ Bonding T1 links enable service ranging from 1.5 Mbps through 12 Mbps ■ Bonding E1 links enable service ranging from 2 Mbps through 16 Mbps ■ Loopback function that encapsulates and de-encapsulates packets

Software features	For a list of the software features available for services PICs, see the *JUNOS Services Interfaces Configuration Guide*.
	■ Protocol support:
	  ■ Multilink PPP (MLPPP)
	  ■ Multilink Frame Relay (MLFR)—FRF.15 and FRF.16
	  ■ Link fragmentation and interleaving (LFI)—FRF.12
	  ■ LFI over MLPPP
	■ IP-IP unicast tunneling
	■ GRE unicast tunneling
	■ PIM sparse mode unicast tunneling

LEDs	One bicolor: ■ Off—PIC is offline ■ Green—PIC is online and at least one configured bundle is operating ■ Amber—PIC is online, but no configured bundles are operating

SONET/SDH OC3c/STM1 PIC



Software release	■ JUNOS 3.1 and later
Description	■ Four OC3 ports ■ Power requirements: 0.49 A/48 V @ 23.7 W
Hardware features	■ Multiplexing and demultiplexing ■ Rate policing on input ■ Rate shaping on output ■ Packet buffering, Layer 2 parsing

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

Cables and connectors	■ Duplex SC/PC connector (Rx and Tx) ■ Optical interface support—See Table 15 on page 58 **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 System Basics and Services Command Reference*.
LEDs	One tricolor per port: ■ Off—Not enabled ■ Green—Online with no alarms or failures ■ Amber—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
  - Bit interleaved parity (BIP) error B2
  - Bit interleaved parity (BIP) error B3
  - Loss of frame (LOF)
  - Loss of pointer (LOP-P)
  - Loss of signal (LOS)
  - Far-end bit error: remote error indication—line (REI-L) (CV-LFE)
  - Far-end bit error: remote error indication—path (REI-P) (CV-PFE)
  - Payload mismatch (path 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:
  - Multiplex section alarm indication signal (MS-AIS)
  - 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
  - Bit interleaved parity (BIP) error B2
  - Bit interleaved parity (BIP) error B3
  - Loss of frame (LOF)
  - Loss of pointer (HP-LOP)
  - Loss of signal (LOS)
  - Multiplex section remote error indication (MS-REI)
  - Higher path label mismatch (HP-PLM)
  - Higher path unequipped (HP-UNEQ)
  - Multiplex section remote defect indication (MS-RDI)
  - Higher path remote defect indication (HP-RDI)
- 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)

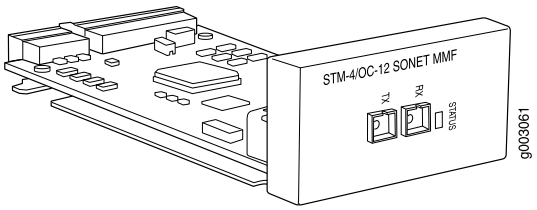
Table 15: Optical Interface Support for SONET/SDH OC3c/STM1 PICs

Parameter	Intermediate Reach	Multimode
Optical interface	Single-mode	Multimode
Transceiver type	Fixed	Fixed

Table 15: Optical Interface Support for SONET/SDH OC3c/STM1 PICs *(continued)*

Parameter	Intermediate Reach	Multimode
Standard	Telcordia GR-253	Multivendor agreement
Maximum distance	SMF cable: 9.3 miles/15 km	MMF cable: 1.2 miles/2 km
Transmitter wavelength	1260 through 1360 nm	1270 through 1380 nm
Average launch power	–15 through –8 dBm	–20 through –14 dBm
Receiver saturation	–8 dBm	–14 dBm
Receiver sensitivity	–28 dBm	–30 dBm

SONET/SDH OC12c/STM4 PIC



Software release	■ JUNOS 3.1 and later
Description	■ One port ■ Power requirement: 0.23 A @ 48 V (10.8 W)
Hardware features	■ Multiplexing and demultiplexing ■ Rate policing on input ■ Rate shaping on output ■ Packet buffering, Layer 2 parsing

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

Cables and connectors	■ Duplex SC/PC connector (Rx and Tx) ■ Optical interface support—See Table 16 on page 61 **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 System Basics and Services Command Reference*.
LEDs	One tricolor per port: ■ Off—Not enabled ■ Green—Online with no alarms or failures ■ Amber—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
  - Bit interleaved parity (BIP) error B2
  - Bit interleaved parity (BIP) error B3
  - Loss of frame (LOF)
  - Loss of pointer (LOP-P)
  - Loss of signal (LOS)
  - Far-end bit error: remote error indication—line (REI-L) (CV-LFE)
  - Far-end bit error: remote error indication—path (REI-P) (CV-PFE)
  - Payload mismatch (path 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:
  - Multiplex section alarm indication signal (MS-AIS)
  - 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
  - Bit interleaved parity (BIP) error B2
  - Bit interleaved parity (BIP) error B3
  - Loss of frame (LOF)
  - Loss of pointer (HP-LOP)
  - Loss of signal (LOS)
  - Multiplex section remote error indication (MS-REI)
  - Higher path label mismatch (HP-PLM)
  - Higher path unequipped (HP-UNEQ)
  - Multiplex section remote defect indication (MS-RDI)
  - Higher path remote defect indication (HP-RDI)
- 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)

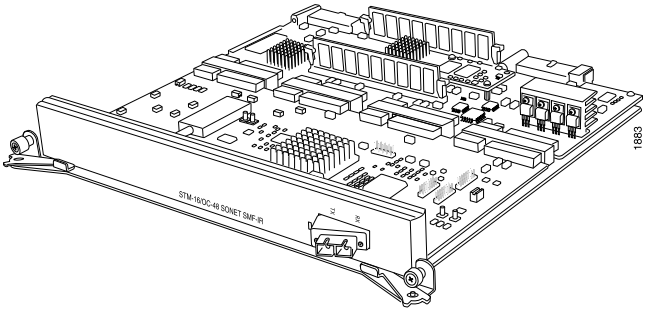
Table 16: Optical Interface Support for SONET/SDH OC12c/STM4 PICs

Parameter	Intermediate Reach	Multimode
Optical interface	Single-mode	Multimode
Transceiver type	Fixed	Fixed

Table 16: Optical Interface Support for SONET/SDH OC12c/STM4 PICs *(continued)*

Parameter	Intermediate Reach	Multimode
Standard	Telcordia GR-253	Multivendor agreement
Maximum distance	SMF cable: 9.3 miles/15 km	MMF cable: 546.8 yards/500 m
Transmitter wavelength	1274 through 1356 nm	1270 through 1380 nm
Average launch power	–15 through –8 dBm	–20 through –14 dBm
Receiver saturation	–8 dBm	–14 dBm
Receiver sensitivity	–28 dBm	–26 dBm

SONET/SDH OC48c/STM16 PIC



Software release	■ JUNOS 6.1 and later
Description	■ One OC48 port ■ Power requirements: 0.86 A @ 48 V (41.4 W)
Hardware features	■ Multiplexing and demultiplexing on the 1-port PIC ■ Rate policing on input ■ Rate shaping on output ■ Packet buffering, Layer 2 parsing

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

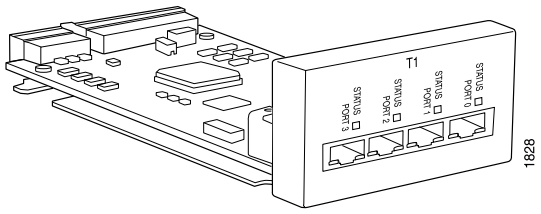
Cables and connectors	You can install any transceiver supported by the PIC. For information about installing and removing transceivers, see the *PIC and Transceiver Installation Instructions*. ■ Duplex LC/PC Connector (Rx and Tx) ■ Optical interface support—See Table 17 on page 65 **NOTE:** To extend 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 System Basics and Services Command Reference*.

LEDs	One tricolor per port: ■ Off—Not enabled ■ Green—Online with no alarms or failures ■ Amber—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 ■ Bit interleaved parity (BIP) error B2 ■ Bit interleaved parity (BIP) error B3 ■ Loss of frame (LOF) ■ Loss of pointer (LOP-P) ■ Loss of signal (LOS) ■ Far-end bit error: remote error indication—line (REI-L) (CV-LFE) ■ Far-end bit error: remote error indication—path (REI-P) (CV-PFE) ■ Payload mismatch (path 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: ■ Multiplex section alarm indication signal (MS-AIS) ■ 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 ■ Bit interleaved parity (BIP) error B2 ■ Bit interleaved parity (BIP) error B3 ■ Loss of frame (LOF) ■ Loss of pointer (HP-LOP) ■ Loss of signal (LOS) ■ Multiplex section remote error indication (MS-REI) ■ Higher path label mismatch (HP-PLM) ■ Higher path unequipped (HP-UNEQ) ■ Multiplex section remote defect indication (MS-RDI) ■ Higher path remote defect indication (HP-RDI) ■ 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)

Table 17: Optical Interface Support for SONET/SDH OC48c/STM16 PICs with SFP

Parameter	Short Reach (SR)	Intermediate Reach (IR)	Long Reach (LR)
Optical interface	Single-mode	Single-mode	Single-mode; compatible with 1550-nm single-mode LR
Transceiver type	SFP	SFP	SFP
Maximum distance	SMF cable: 1.24 miles/2 km	SMF cable: 9.3 miles/15 km	SMF cable: 49.71 miles/80 km
Standard	Telcordia GR-253	Telcordia GR-253	Telcordia GR-253—L-16.3
Transmitter wavelength	1266 through 1360 nm	1260 through 1360 nm	1500 through 1580 nm
Average launch power	–10 through –3 dBm	–5 through 0 dBm	–2 through +3 dBm
Receiver saturation	–3 dBm	0 dBm	–9 dBm
Receiver sensitivity	–18 dBm	–18 dBm	–28 dBm

T1 PIC

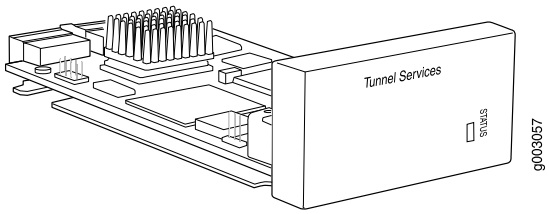


Software release	■ JUNOS 4.1 and later
Description	■ Four T1 ports ■ Power requirement: 0.08 A @ 48 V (3.7 W) ■ Supports clear channel T1 per port (1.544 Mbps per channel) ■ Supports attenuation up to –12 dBm
Hardware features	■ Per-port loop timing ■ Onboard DSU functionality for T1 connectivity

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 ■ Amber—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

Tunnel Services PIC



Software release	■ JUNOS 3.3 and later
Description	■ Power requirement: 0.07 A @ 48 V (3.4 W)
Hardware features	■ Loopback function that encapsulates and de-encapsulates packets ■ SONET/SDH OC12/STM4 tunneling bandwidth
Software features	For a list of the software features available for services PICs, see the *JUNOS 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 ■ Amber—Online with alarms for remote failures ■ Red—Active with a local alarm; router has detected a failure

M20 Internet Router PIC Guide

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Revision History
15 November 2007—530-022506-01. Revision 1. Updated hardware features for the E1 PIC. Added first supported release for the software features on Services PICs.
29 June 2007—530-015876-01. Revision 4. Added Adaptive Services II PICs.
30 March 2007—530-015876-01. Revision 3. Removed Adaptive Services, Monitoring Services, and Multichannel DS3 PICs.
12 January 2007—530-015876-01. Revision 2. Added optical diagnostic support for the 1-port Gigabit Ethernet IQ2 PIC with SFP, 4-port Type 1 Gigabit Ethernet IQ2 PIC with SFP, and SONET/SDH OC48c/STM16 PIC. Corrected LEDs for Gigabit Ethernet IQ2 PIC with SFP.
20 November 2006—530-015876-01. Revision 1. Added 4-port Type 1 Gigabit Ethernet IQ2 PIC and the Adaptive Services Layer 2 Services PIC. Added product reclamation and recycling appendix. Clarified software features for Gigabit Ethernet PIC with SFP. Updated the throughput speed for the Adaptive Services PIC. Added FPCs supported for the M20 router and a PIC/FPC compatibility matrix. Removed the end-of-life M20/M40 FPC (M20-FPC-E).
9 January 2006—530-013671-01. Revision 2. Removed M5 and M10 router references to the Enhanced FPC.
14 September 2005—530-013671-01. Added Channelized 10-port T1 PIC.
15 January 2005—530-012538-01. Removed Gigabit Ethernet PIC. Added Channelized OC3 IQ PIC. Added the PIC Feature Matrix table.
9 November 2004—Revision 2.
6 July 2004 —Revision 1. Clarified description, hardware features, and counters for EIA-530 PIC.

The information in this document is current as of the date listed in the revision history.

YEAR 2000 NOTICE

Juniper Networks hardware and software products are Year 2000 compliant. The JUNOS software has no known time-related limitations through the year 2038. However, the NTP application is known to have some difficulty in the year 2036.