



## **M20 Internet Router**

## **PIC Guide**

### *End-of-Life PICs*

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Part Number: 530-010561-01, Revision 7

This guide provides an overview and description of the Physical Interface Cards (PICs) supported by the Juniper Networks M20 Internet router that are end-of-life and can no longer be ordered. The PICs are described alphabetically. Table 1 on page 3 lists the end-of-life 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.



**NOTE:** A single FPC slot has a maximum throughput of 3.2 Gbps. Inserting a combination of PICs with an aggregate higher than that is supported, but constitutes oversubscription.

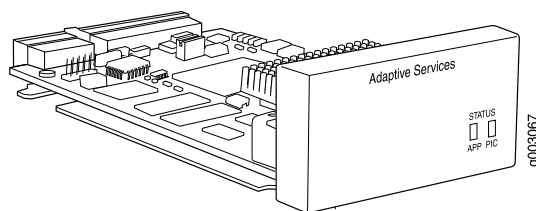
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Blank PICs resemble other PICs, but do not provide any physical connection or activity. When a slot is not occupied by a PIC, you must insert a blank PIC to fill the empty slot and ensure proper cooling of the system.

**Table 1: End-of-Life PICs Supported in the M20 Internet Router**

<b>PIC Family and Type</b>	<b>Ports</b>	<b>First JUNOS Support</b>	<b>PIC Slots Required</b>	<b>Page</b>
<b>ATM</b>				
ATM DS3	4	4.3	1 slot	6
ATM E3	4	4.3	1 slot	8
ATM OC3	2	3.1	1 slot	10
ATM OC12	1	3.1	1 slot	12
<b>Channelized</b>				
Channelized DS3	4	4.2	1 slot	14
Channelized E1	10	5.1	1 slot	16
Channelized STM1 to E1	1	4.4	1 slot	17
Multichannel DS3	2	5.1	1 slot	26
<b>E3</b>				
E3	4	3.1	1 slot	19
<b>Ethernet</b>				
Gigabit Ethernet	1	3.2	1 slot	21
Gigabit Ethernet	4	4.2	Entire FPC slot	23
<b>Services</b>				
Adaptive Services	0	6.0	1 slot	4
Monitoring Services	1	5.6	1 slot	25
Multilink	0	4.3	1 slot	28
<b>SONET/SDH</b>				
SONET/SDH OC48c/STM16	1	3.1	Entire FPC slot	30

## Adaptive Services PIC



<b>Software release</b>	<ul style="list-style-type: none"> <li>■ JUNOS 6.0 and later</li> </ul>
<b>Description</b>	<ul style="list-style-type: none"> <li>■ Supports tunnel services. This feature is included with the PIC and does not require an individual license.</li> <li>■ 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 <i>JUNOS Services Interfaces Configuration Guide</i>.</li> <li>■ Power requirement: 0.4 A @ 48 V (19 W)</li> </ul>
<b>Hardware features</b>	<ul style="list-style-type: none"> <li>■ Throughput speeds up to 800 Mbps of unidirectional traffic or 400 Mbps of bidirectional traffic, determined by packet size</li> <li>■ Active monitoring on any interface up to 250,000 packets per second</li> <li>■ Support for MTUs up to 9192 bytes for Gigabit Ethernet and SONET interfaces</li> </ul>
<b>Software features</b>	<p>For a list of the software features available for services PICs, see the <i>JUNOS Services Interfaces Configuration Guide</i>.</p> <p>Depending on your JUNOS release and individual licenses, software features for this PIC can include:</p> <ul style="list-style-type: none"> <li>■ Stateful firewall with packet inspection <ul style="list-style-type: none"> <li>■ Detects SYN attacks, ICMP and UDP floods, and ping of death attacks</li> </ul> </li> <li>■ NAT for IP addresses</li> <li>■ Port Address Translation (PAT) for port numbers</li> <li>■ J-Flow accounting exports cflowd version 5 and version 8 records</li> <li>■ Tunnel services: <ul style="list-style-type: none"> <li>■ IP-IP unicast tunneling</li> <li>■ GRE unicast tunneling—supports GRE fragmentation</li> <li>■ PIM sparse mode unicast tunneling</li> <li>■ Virtual loopback tunnel interface for VRF table lookup</li> </ul> </li> <li>■ IPSec encryption</li> <li>■ Voice services: <ul style="list-style-type: none"> <li>■ Compressed Real-Time Transport Protocol (CRTP)</li> <li>■ Compressed User Datagram Protocol (CUDP)</li> </ul> </li> <li>■ Encapsulations: <ul style="list-style-type: none"> <li>■ High-Level Data Link Control (HDLC)</li> <li>■ Point-to-Point Protocol (PPP)</li> </ul> </li> </ul>

**LEDs**

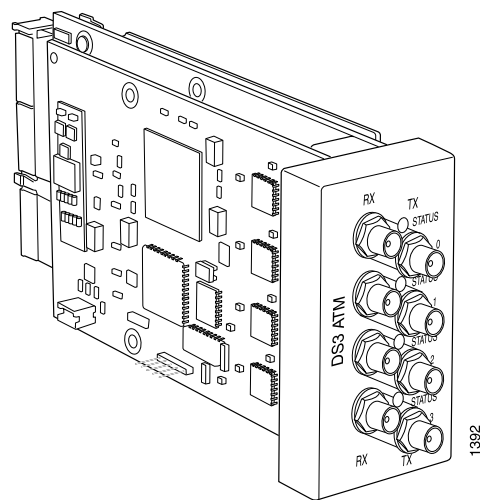
Status LED, one tricolor:

- 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 tricolor:

- Off—Service is not running.
  - Green—Service is running under acceptable load.
  - Amber—Service is overloaded.
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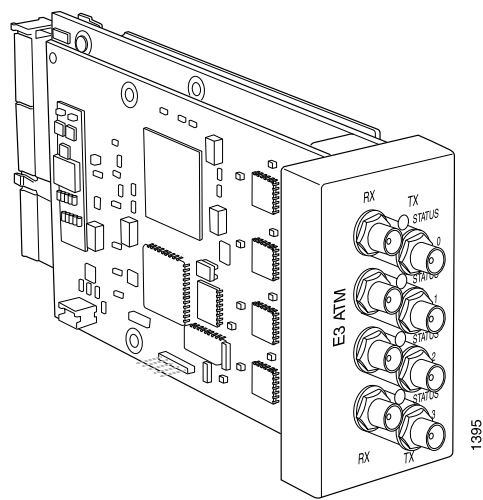
ATM DS3 PIC



Software release	<ul style="list-style-type: none"><li>JUNOS 4.3 and later</li></ul>
Description	<ul style="list-style-type: none"><li>Four DS3 ports</li><li>Power requirement: 0.39 A @ 48 V (19 W)</li><li>Conforms to ANSI T1.105-1991 and T1E1.2/93-020R1</li><li>Asynchronous Transfer Mode (ATM) standards compliant</li><li>Alarm and event counting and detection</li><li>Compatible with well-known ATM switches</li><li>ATM switch ID, which displays the switch IP address and local interface name of the adjacent Fore ATM switches</li></ul>
Hardware features	<ul style="list-style-type: none"><li>OAM fault management processes Alarm Indication Signal (AIS) and Remote Defect Indicator (RDI) cells</li><li>ASIC-based packet segmentation and reassembly (SAR) management and output port queuing</li><li>16-MB SDRAM memory for ATM SAR</li><li>Packet buffering, Layer 2 parsing</li><li>Configurable framing options:<ul style="list-style-type: none"><li>C-bit with ATM direct mapping</li><li>C-bit with PLCP framing (default)</li><li>M23 ATM direct mapping</li><li>M23 with PLCP framing</li></ul></li></ul>

<b>Software features</b>	<ul style="list-style-type: none"> <li>■ Multiprotocol Label Switching (MPLS) circuit cross-connect (CCC) for leveraging ATM access networks</li> <li>■ Support for user-configurable virtual circuits (VC) and virtual paths (VP)</li> <li>■ 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)</li> <li>■ Unspecified bit rate (UBR) traffic shaping</li> <li>■ Fine-grained variable bit rate (VBR) traffic shaping</li> <li>■ Outbound PIC queues cells on a per-VC basis</li> <li>■ Encapsulations—AAL5 subnetwork attachment point (SNAP)</li> </ul>
<b>Cables and connectors</b>	<ul style="list-style-type: none"> <li>■ 10-ft (3.05-m) posilock SMB to BNC</li> <li>■ Four pairs of RX and TX coaxial cables</li> </ul>
<b>LEDs</b>	<p>One tricolor per port:</p> <ul style="list-style-type: none"> <li>■ Off—Not enabled</li> <li>■ Green—Online with no alarms or failures</li> <li>■ Amber—Online with alarms for remote failures</li> <li>■ Red—Active with a local alarm; router has detected a failure</li> </ul>
<b>Alarms, errors, and events</b>	<ul style="list-style-type: none"> <li>■ Alarm Indication Signal (AIS)</li> <li>■ Far-end Block Error (FEBE)</li> <li>■ Frame Error</li> <li>■ Idle code</li> <li>■ Idle received</li> <li>■ Local and remote loopback</li> <li>■ Loss of Signal (LoS)</li> <li>■ Out of Frame (OoF)</li> <li>■ Path parity error</li> <li>■ Yellow alarm</li> </ul>

ATM E3 PIC

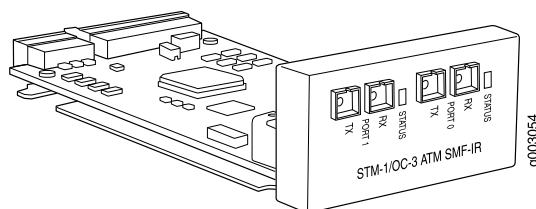


Software release	<ul style="list-style-type: none"><li>JUNOS 4.3 and later</li></ul>
Description	<ul style="list-style-type: none"><li>Four E3 ports</li><li>Power requirement: 0.43 A @ 48 V (20.8 W)</li><li>Conforms to ANSI T1.105-1991 and T1E1.2/93-020R1</li><li>Asynchronous Transfer Mode (ATM) standards compliant</li><li>Alarm and event counting and detection</li><li>Compatible with well-known ATM switches</li><li>ATM switch ID, which displays the switch IP address and local interface name of the adjacent Fore ATM switches</li></ul>
Hardware features	<ul style="list-style-type: none"><li>OAM fault management processes Alarm Indication Signal (AIS) and Remote Defect Indicator (RDI) cells</li><li>ASIC-based packet segmentation and reassembly (SAR) management and output port queuing</li><li>16-MB SDRAM memory for ATM SAR</li><li>Packet buffering, Layer 2 parsing</li><li>Configurable framing options:<ul style="list-style-type: none"><li>G.751 direct mapping</li><li>G.751 with PLCP encapsulation (default)</li><li>G.832 ATM direct mapping</li></ul></li></ul>



<b>Software features</b>	<ul style="list-style-type: none"> <li>■ Multiprotocol Label Switching (MPLS) circuit cross-connect (CCC) for leveraging ATM access networks</li> <li>■ Support for user-configurable virtual circuits (VC) and virtual paths (VP)</li> <li>■ 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)</li> <li>■ Unspecified bit rate (UBR) traffic shaping</li> <li>■ Fine-grained variable bit rate (VBR) traffic shaping</li> <li>■ Outbound PIC queues cells on a per-VC basis</li> <li>■ Encapsulations—AAL5 subnetwork attachment point (SNAP)</li> </ul>
<b>Cables and connectors</b>	<ul style="list-style-type: none"> <li>■ 10-ft (3.05-m) posilock SMB to BNC</li> <li>■ Four pairs of RX and TX coaxial cables</li> </ul>
<b>LEDs</b>	<p>One tricolor per port:</p> <ul style="list-style-type: none"> <li>■ Off—Not enabled</li> <li>■ Green—Online with no alarms or failures</li> <li>■ Amber—Online with alarms for remote failures</li> <li>■ Red—Active with a local alarm; router has detected a failure</li> </ul>
<b>Alarms, errors, and events</b>	<ul style="list-style-type: none"> <li>■ Alarm Indication Signal (AIS)</li> <li>■ Frame Error</li> <li>■ Line code violation</li> <li>■ Local and remote loopback</li> <li>■ Loss of Signal (LoS)</li> <li>■ Out of Frame (OoF)</li> <li>■ Yellow alarm</li> </ul>

## ATM OC3 PIC



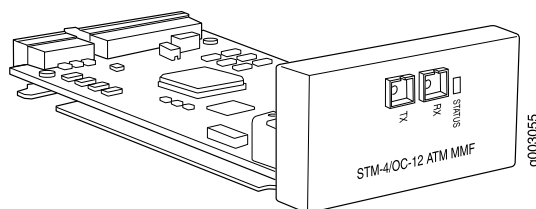
<b>Software release</b>	<ul style="list-style-type: none"> <li>■ JUNOS 3.1 and later</li> </ul>
<b>Description</b>	<ul style="list-style-type: none"> <li>■ Two OC3 ports</li> <li>■ Power requirement: 0.49 A @ 48 V (23.7 W)</li> <li>■ Conforms to ANSI T1.105-1991 and T1E1.2/93-020R1</li> <li>■ ATM and SONET/SDH standards compliant</li> <li>■ Alarm and event counting and detection</li> <li>■ Compatible with well-known ATM switches</li> <li>■ ATM switch ID, which displays the switch IP address and local interface name of the adjacent Fore ATM switches</li> <li>■ Optical interface support—see Table 2 on page 11</li> </ul>
<b>Hardware features</b>	<ul style="list-style-type: none"> <li>■ Dual 3010 SAR for segmentation and reassembly into 53-byte ATM cells</li> <li>■ High-performance parsing of SONET/SDH frames</li> <li>■ OAM fault management processes Alarm Indication Signal (AIS) and Remote Defect Indicator (RDI) cells</li> <li>■ ASIC-based packet segmentation and reassembly (SAR) management and output port queuing</li> <li>■ 16-MB SDRAM memory for ATM SAR</li> <li>■ Packet buffering, Layer 2 parsing</li> </ul>
<b>Software features</b>	<ul style="list-style-type: none"> <li>■ Multiprotocol Label Switching (MPLS) circuit cross-connect (CCC) for leveraging ATM access networks</li> <li>■ Support for user-configurable virtual circuits (VC) and virtual paths (VP)</li> <li>■ 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)</li> <li>■ Unspecified bit rate (UBR) traffic shaping</li> <li>■ Fine-grained variable bit rate (VBR) traffic shaping</li> <li>■ Outbound PIC queues cells on a per-VC basis</li> <li>■ Encapsulations—AAL5 subnetwork attachment point (SNAP)</li> </ul>
<b>Cables and connectors</b>	<ul style="list-style-type: none"> <li>■ Duplex SC/PC connector (RX and TX)</li> </ul>

<b>LEDs</b>	<p>One tricolor per port:</p> <ul style="list-style-type: none"> <li>■ Off—Not enabled</li> <li>■ Green—Online with no alarms or failures</li> <li>■ Amber—Online with alarms for remote failures</li> <li>■ Red—Active with a local alarm; router has detected a failure</li> </ul>
<b>Alarms, errors, and events</b>	<ul style="list-style-type: none"> <li>■ Alarm indication signal (AIS-L, AIS-P)</li> <li>■ Bit error rate signal degrade (BERR-SD), Bit error rate signal fail (BERR-SF)</li> <li>■ Bit interleaved parity errors B1, B2, B3</li> <li>■ 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)</li> <li>■ Loss of cell delineation (LOC), Loss of frame (LOF), Loss of pointer (LOP-P), Loss of signal (LOS)</li> <li>■ Payload mismatch (PLM-P), Payload unequipped (UNEQ-P)</li> <li>■ Remote defect indication (RDI-L, RDI-P)</li> <li>■ 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)</li> </ul>

**Table 2: Optical Interface Support for ATM OC3 PICs**

<b>PIC Type</b>	<b>Single-Mode Intermediate Reach</b>	<b>Multimode</b>
Optical interface	Single-mode, intermediate reach (Telcordia GR-253 compliant) with SC/PC duplex connector (maximum distance 9.3 miles/15 km)	Multimode with SC/PC duplex connector (maximum distance 1.2 miles/2 km), ATM Forum af-phy-0046
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

## ATM OC12 PIC



<b>Software release</b>	<ul style="list-style-type: none"> <li>■ JUNOS 3.1 and later</li> </ul>
<b>Description</b>	<ul style="list-style-type: none"> <li>■ One OC12 port</li> <li>■ Power requirement: 0.43 A @ 48 V (20.8 W)</li> <li>■ Conforms to ANSI T1.105-1991 and T1E1.2/93-020R1</li> <li>■ ATM and SONET/SDH standards compliant</li> <li>■ Alarm and event counting and detection</li> <li>■ Compatible with well-known ATM switches</li> <li>■ ATM switch ID, which displays the switch IP address and local interface name of the adjacent Fore ATM switches</li> </ul>
<b>Hardware features</b>	<ul style="list-style-type: none"> <li>■ High-performance parsing of SONET/SDH frames</li> <li>■ OAM fault management processes Alarm Indication Signal (AIS) and Remote Defect Indicator (RDI) cells</li> <li>■ ASIC-based packet segmentation and reassembly (SAR) management and output port queuing</li> <li>■ 16-MB SDRAM memory for ATM SAR</li> <li>■ Packet buffering, Layer 2 parsing</li> </ul>
<b>Software features</b>	<ul style="list-style-type: none"> <li>■ Multiprotocol Label Switching (MPLS) circuit cross-connect (CCC) for leveraging ATM access networks</li> <li>■ Support for user-configurable virtual circuits (VC) and virtual paths (VP)</li> <li>■ 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)</li> <li>■ Unspecified bit rate (UBR) traffic shaping</li> <li>■ Fine-grained variable bit rate (VBR) traffic shaping</li> <li>■ Outbound PIC queues cells on a per-VC basis</li> <li>■ Encapsulations—AAL5 subnetwork attachment point (SNAP)</li> </ul>
<b>Cables and connectors</b>	<ul style="list-style-type: none"> <li>■ Duplex SC/PC connector (RX and TX)</li> <li>■ Optical interface support—see Table 3 on page 13</li> </ul>
<b>LEDs</b>	<p>One tricolor per port:</p> <ul style="list-style-type: none"> <li>■ Off—Not enabled</li> <li>■ Green—Online with no alarms or failures</li> <li>■ Amber—Online with alarms for remote failures</li> <li>■ Red—Active with a local alarm; router has detected a failure</li> </ul>

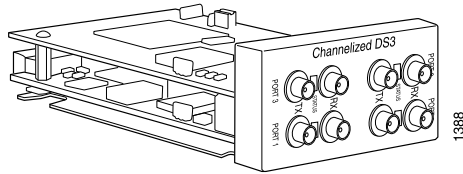
**Alarms, errors, and events**

- 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 3: Optical Interface Support for ATM OC12 PICs**

PIC Type	Single-Mode Intermediate Reach	Multimode
Optical interface	Single-mode, intermediate reach (Telcordia GR-253 compliant) with SC/PC duplex connector (maximum distance 9.3 miles/15 km)	Multimode with SC/PC duplex connector (maximum distance 546.8 yards/500 m), ATM Forum af-phy-0046
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 PIC

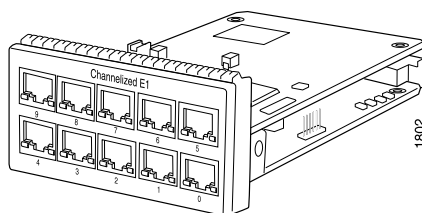


<b>Software release</b>	<ul style="list-style-type: none"> <li>■ JUNOS 4.2 and later</li> </ul>
<b>Description</b>	<ul style="list-style-type: none"> <li>■ Four DS3 ports</li> <li>■ Power requirement: 0.32 A @ 48 V (15.6 W)</li> <li>■ Supports up to 28 T1 channels per port</li> <li>■ Data Service Unit (DSU) functionality</li> </ul>
<b>Hardware features</b>	<ul style="list-style-type: none"> <li>■ Each T1 channel supports a single High-level Data Link Control (HDLC) framer that can be configured for speeds ranging from DS0 (64 Kbps) through full T1 (1.54 Mbps)</li> <li>■ Predictable throughput on all ports at 1.54 Mbps, full duplex</li> <li>■ Rate limiting on input and output</li> <li>■ Packet buffering, Layer 2 parsing</li> </ul>
<b>Software features</b>	<ul style="list-style-type: none"> <li>■ DS3 alarm and event counting</li> <li>■ DS3 alarm and event detection</li> <li>■ DS3 diagnostics and loopback control</li> <li>■ B3ZS line encoding</li> <li>■ M13 or C-bit parity</li> <li>■ DS3 Simple Network Management Protocol (SNMP) support (DS3 MIB)</li> <li>■ Per-packet counts and byte counts</li> <li>■ Local and remote loopback testing</li> <li>■ Encapsulations: <ul style="list-style-type: none"> <li>■ High-Level Data Link Control (HDLC)</li> <li>■ Frame Relay</li> <li>■ Circuit cross-connect (CCC)</li> <li>■ Translational cross-connect (TCC)</li> <li>■ Point-to-Point Protocol (PPP)</li> </ul> </li> </ul>
<b>Cables and connectors</b>	<ul style="list-style-type: none"> <li>■ Custom 10-ft (3.05-m) posilock to BNC male cable, separate RX and TX</li> </ul>
<b>LEDs</b>	<p>One tricolor per port:</p> <ul style="list-style-type: none"> <li>■ Off—Not enabled</li> <li>■ Green—Online with no alarms or failures</li> <li>■ Amber—Online with alarms for remote failures</li> <li>■ Red—Active with a local alarm; router has detected a failure</li> </ul>

**Alarms, errors, and events**

- Alarm Indication Signal (AIS)
  - Bit error rate (BER)
  - Equipment failure (Does not affect service)
  - Excessive zeros (EXZ)
  - Far-end Block Error (FEBE)
  - Frame error
  - Idle code, Idle received
  - Line code violation (LCV)
  - 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
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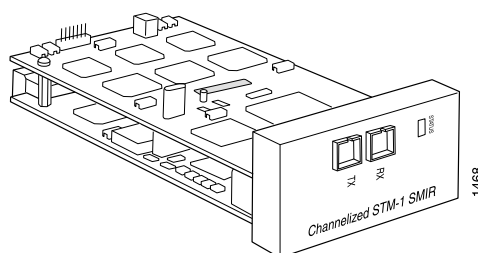
## Channelized E1 PIC



<b>Software release</b>	<ul style="list-style-type: none"> <li>■ JUNOS 5.1 and later</li> </ul>
<b>Description</b>	<ul style="list-style-type: none"> <li>■ Ten E1 ports</li> <li>■ Power requirement: 0.15 A/48 V @ 7.2 W</li> <li>■ Supports up to 24 NxDS0 channels per port</li> <li>■ Data Service Unit (DSU) functionality</li> </ul>
<b>Hardware features</b>	<ul style="list-style-type: none"> <li>■ Ports configurable as clear channel E1 interfaces with 2.048-Mbps connectivity</li> <li>■ Rate limiting on input and output</li> <li>■ Packet buffering, Layer 2 parsing</li> </ul>
<b>Software features</b>	<ul style="list-style-type: none"> <li>■ Four data-link connection identifiers (DLCIs) per logical customer channel</li> <li>■ Unframed E1 G.703 and G.704 framing modes</li> <li>■ HDB3 line coding</li> <li>■ CRC4 configurable</li> <li>■ Per-packet counts and byte counts</li> <li>■ Local and remote loopback testing</li> <li>■ Encapsulations:             <ul style="list-style-type: none"> <li>■ High-Level Data Link Control (HDLC)</li> <li>■ Frame Relay</li> <li>■ Circuit cross-connect (CCC)</li> <li>■ Translational cross-connect (TCC)</li> <li>■ Point-to-Point Protocol (PPP)</li> </ul> </li> </ul>
<b>Cables and connectors</b>	<ul style="list-style-type: none"> <li>■ 128-ohm RJ-48C</li> </ul>
<b>LEDs</b>	<p>One bicolor per port:</p> <ul style="list-style-type: none"> <li>■ Off—Port not enabled</li> <li>■ Green—Physical E1 link is up; individual subchannels can be down</li> <li>■ Red—Physical E1 link is down</li> </ul>
<b>Alarms, errors, and events</b>	<ul style="list-style-type: none"> <li>■ Alarm Indication Signal (AIS)</li> <li>■ Loss of Frame (LoF)</li> <li>■ Out of Frame (OoF)</li> <li>■ Failed Signal Rate (FSR)</li> </ul>



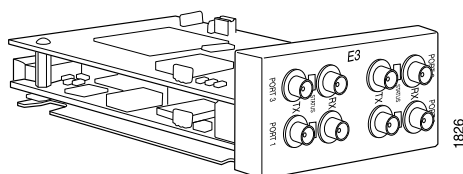
## Channelized STM1 to E1 PIC



Software release	<ul style="list-style-type: none"> <li>■ JUNOS 4.4 and later</li> </ul>
Description	<ul style="list-style-type: none"> <li>■ Four E3 ports</li> <li>■ Power requirement: 0.32 A/48 V @ 15.3 W</li> <li>■ 63 E1 channels</li> </ul>
Hardware features	<ul style="list-style-type: none"> <li>■ Each E1 channel supports a single High-level Data Link Control (HDLC) framer that can be configured for speeds from DS0 (64 Kbps) through full E1 (2 Mbps) in 64-Kbps increments</li> <li>■ Onboard DSU functionality for E1 and fractional E1 connectivity</li> <li>■ Integrated support for G.703 and unframed mode and G.704 framed mode with CRC; this feature is user-configurable</li> <li>■ Configurable clock source: Internal or loop</li> <li>■ Per-port loop timing</li> <li>■ Rate limiting on input and output</li> <li>■ Nx E1 service with Multilink Point-to-Point Protocol (MLPPP, RFC 1990) delivered by the Link Services and Multilink Services PICs</li> </ul>
Software features	<ul style="list-style-type: none"> <li>■ SDH mapping: <ul style="list-style-type: none"> <li>■ Tributary Unit Group 3 (TUG-3)</li> </ul> </li> <li>■ E1 support: <ul style="list-style-type: none"> <li>■ Full instrumentation per E1 channel</li> <li>■ Integrated support for G.703 unframed mode and G.704 framed mode</li> <li>■ 4-bit CRC for G.704 framed mode</li> <li>■ HDB3 coding</li> <li>■ Local E1 line loopback and remote line loopback</li> <li>■ Per-channel BERT testing</li> </ul> </li> <li>■ Encapsulations: <ul style="list-style-type: none"> <li>■ Cisco High-level Data Link Control (HDLC)</li> <li>■ Frame Relay</li> <li>■ Multiprotocol Label Switching (MPLS) circuit cross-connect (CCC)</li> <li>■ MPLS translational cross-connect (TCC)</li> <li>■ Point-to-Point Protocol (PPP)</li> </ul> </li> </ul>

<b>Cables and connectors</b>	<ul style="list-style-type: none"> <li>■ Single-mode fiber</li> <li>■ Duplex SC/PC connector (RX and TX)</li> </ul>
<b>LEDs</b>	<p>One tricolor per port:</p> <ul style="list-style-type: none"> <li>■ Off—Not enabled</li> <li>■ Green—Online with no alarms or failures</li> <li>■ Amber—Online with alarms for remote failures</li> <li>■ Red—Active with a local alarm; router has detected a failure</li> </ul>
<b>Alarms, errors, and events</b>	<ul style="list-style-type: none"> <li>■ Alarm Indication Signal (AIS)</li> <li>■ Bit Error Rate Signal Degrade (BERR-SD), Bit Error Rate Signal Fail (BERR-SF)</li> <li>■ Bit Error Rate Testing (BERT) per E1 channel</li> <li>■ Bit Interleaved Parity Errors B1, B2, B3 (CV-S, CV-L, CV-P)</li> <li>■ Loss of Frame (LoF), Loss of Pointer (LoP-P), Loss of Signal (LoS)</li> <li>■ Payload Mismatch (PLM-P), Payload Unequipped (UNEQ-P)</li> <li>■ Remote Defect Indication (RDI-L, RDI-P)</li> <li>■ Errored Seconds (ES-S, ES-L, ES-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)</li> <li>■ Yellow alarm bit (X-bit) disagreements</li> </ul>

## E3 PIC

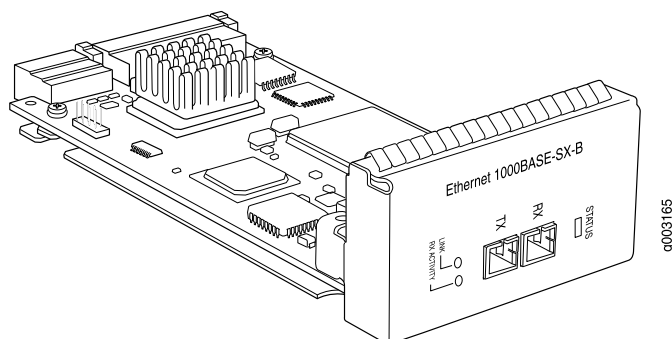


<b>Software release</b>	<ul style="list-style-type: none"> <li>■ JUNOS 3.1 and later</li> </ul>
<b>Description</b>	<ul style="list-style-type: none"> <li>■ Four E3 ports</li> <li>■ Power requirement: 0.47 A @ 48 V (22.5 W)</li> <li>■ Integrated DSU interoperability</li> </ul>
<b>Hardware features</b>	<ul style="list-style-type: none"> <li>■ High-density E3 (34.368-Mbps) connectivity</li> <li>■ High-performance throughput on each port at speeds up to 34.368 Mbps, full duplex</li> <li>■ Scrambling support</li> <li>■ Subrate clocking support</li> <li>■ Rate policing on input</li> <li>■ Rate shaping on output</li> <li>■ Packet buffering, Layer 2 parsing</li> <li>■ Large MTUs, up to 9192 bytes</li> <li>■ Local and remote loopback</li> </ul>
<b>Software features</b>	<ul style="list-style-type: none"> <li>■ Supports G-751 framing</li> <li>■ E3 diagnostics and loopback control</li> <li>■ E3 alarm and event counting and detection</li> <li>■ DS3 diagnostics and loopback control</li> <li>■ Bit error rate test (BERT); you can configure one port in BERT mode and configure the remaining channels to transmit and receive normal traffic</li> <li>■ Encapsulations: <ul style="list-style-type: none"> <li>■ High-level Data Link Control (HDLC)</li> <li>■ Frame Relay</li> <li>■ Multiprotocol Label Switching (MPLS) circuit cross-connect (CCC)</li> <li>■ Point-to-Point Protocol (PPP)</li> </ul> </li> </ul>
<b>Cables and connectors</b>	<ul style="list-style-type: none"> <li>■ Custom 10 ft (3.05 m) posilock to BNC male cable, separate RX and TX</li> </ul>
<b>LEDs</b>	<p>One tricolor per port:</p> <ul style="list-style-type: none"> <li>■ Off—Not enabled</li> <li>■ Green—Online with no alarms or failures</li> <li>■ Amber—Online with alarms for remote failures</li> <li>■ Red—Active with a local alarm; router has detected a failure</li> </ul>

**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
-

## Gigabit Ethernet PIC

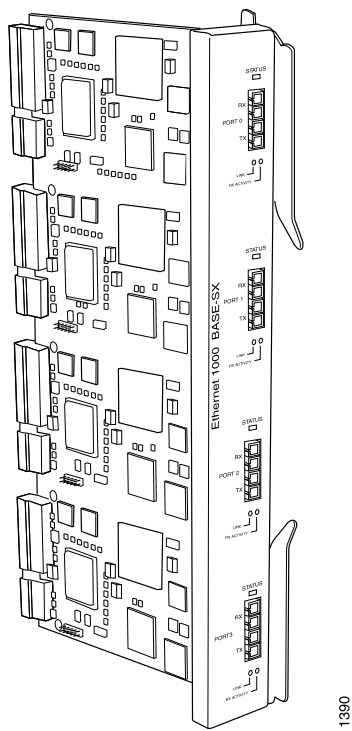


<b>Software release</b>	<ul style="list-style-type: none"> <li>■ JUNOS 3.2 and later</li> </ul>
<b>Description</b>	<ul style="list-style-type: none"> <li>■ One Gigabit Ethernet port</li> <li>■ Power requirement:</li> <li>■ Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network</li> </ul>
<b>Hardware features</b>	<ul style="list-style-type: none"> <li>■ High-performance throughput on all ports at speeds up to 1 Gbps</li> <li>■ Autonegotiation between Gigabit Ethernet circuit partners</li> <li>■ Full-duplex mode</li> <li>■ Maximum transmission units (MTUs) of up to 9192 bytes</li> </ul>
<b>Software features</b>	<ul style="list-style-type: none"> <li>■ Virtual Router Redundancy Protocol (VRRP) support</li> <li>■ 802.1Q virtual LANs (VLANs) support</li> <li>■ 64 source MAC address filters per port</li> <li>■ 960 destination MAC filters per port</li> </ul>
<b>Cables and connectors</b>	<ul style="list-style-type: none"> <li>■ Duplex SC connector (TX and RX)</li> <li>■ Optical interface support—see Table 4 on page 22</li> </ul>
<b>LEDs</b>	<p>Status LEDs, one bicolor:</p> <ul style="list-style-type: none"> <li>■ Off—PIC not enabled</li> <li>■ Green—PIC is operating normally</li> <li>■ Red—PIC has an error or failure</li> </ul> <p>Port LEDs, one pair per port:</p> <ul style="list-style-type: none"> <li>■ Link—If green, the port is online; if there is no light, the port is down</li> <li>■ Activity—If flashing green, the port is receiving data; if there is no light, the port might be on, but is not receiving data</li> </ul>

**Table 4: Optical Interface Support for Gigabit Ethernet PICs**

PIC Type	SX Transceiver	LX Transceiver	LH Transceiver
Optical interface	656 ft/200 m reach on 62.5/125 micrometer multimode fiber (MMF)	6.2 miles/10 km reach on 9/125 micrometer single-mode fiber (SMF)	43.5 miles/70 km reach on 9/125 micrometer SMF
	1640 ft/500 m reach on 50/125 micrometer MMF	1804.5 ft/550 m reach on 62.5/125 and 50/125 micrometer MMF	
Wavelength	830 through 860 nm	1270 through 1355 nm	1480 through 1580 nm
Average launch power	-9.5 through -4 dBm	-11 through -3 dBm	-3 through +2 dBm
Receiver saturation	-3 dBm	-3 dBm	-3 dBm
Receiver sensitivity	-17 dBm	-19 dBm	-23 dBm (BER 1012) for SMF

Gigabit Ethernet PIC (Quad-Wide)



Software release	<ul style="list-style-type: none"><li>■ JUNOS 4.2 and later</li></ul>
Description	<ul style="list-style-type: none"><li>■ Four Gigabit Ethernet ports</li><li>■ Power requirements: 0.40 A @ 48 V (19.2 W)</li><li>■ Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network</li></ul>
Hardware features	<ul style="list-style-type: none"><li>■ High-performance throughput on all ports at speeds up to 1 Gbps</li><li>■ Autonegotiation between Gigabit Ethernet circuit partners</li><li>■ Full-duplex mode</li><li>■ Maximum transmission units (MTUs) of up to 9192 bytes</li></ul>
Software features	<ul style="list-style-type: none"><li>■ Virtual Router Redundancy Protocol (VRRP) support</li><li>■ 802.1Q virtual LANs (VLANs) support</li><li>■ 64 source MAC address filters per port</li><li>■ 960 destination MAC filters per port</li></ul>
Cables and connectors	<ul style="list-style-type: none"><li>■ Duplex SC connector (TX and RX)</li><li>■ Optical interface support—see Table 5 on page 24</li></ul>

**LEDs**

Status LEDs, one bicolor:

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

Port LEDs, one pair per port:

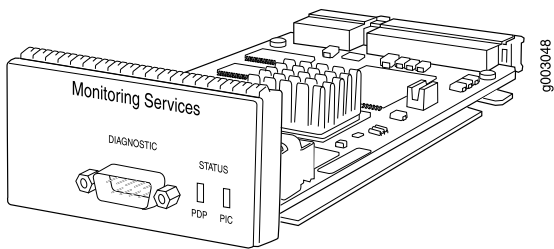
- Link—If green, the port is online; if there is no light, the port is down
- Activity—If flashing green, the port is receiving data; if there is no light, the port might be on, but is not receiving data

**Table 5: Optical Interface Support for Gigabit Ethernet PICs**

PIC Type	SX Transceiver	LX Transceiver	LH Transceiver
Optical interface	656 ft/200 m reach on 62.5/125 micrometer multimode fiber (MMF)	6.2 miles/10 km reach on 9/125 micrometer single-mode fiber (SMF)	43.5 miles/70 km reach on 9/125 micrometer SMF
	1640 ft/500 m reach on 50/125 micrometer MMF	1804.5 ft/550 m reach on 62.5/125 and 50/125 micrometer MMF	
Wavelength	830 through 860 nm	1270 through 1355 nm	1480 through 1580 nm
Average launch power	−9.5 through −4 dBm	−11 through −3 dBm	−3 through +2 dBm
Receiver saturation	−3 dBm	−3 dBm	−3 dBm
Receiver sensitivity	−17 dBm	−19 dBm	−23 dBm (BER 1012) for SMF

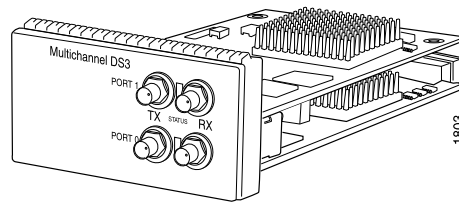


# Monitoring Services PIC



Software release	<ul style="list-style-type: none"><li>■ JUNOS 5.6 and later</li></ul>
Description	<ul style="list-style-type: none"><li>■ Active traffic monitoring</li><li>■ Power requirement: 0.19 A @ 48 V (9 W)</li><li>■ Monitors IPv4 packets</li><li>■ Support for collecting and exporting cflowd records</li></ul>
Hardware features	<ul style="list-style-type: none"><li>■ Monitors up to 100,000 packets per second</li><li>■ Support for MTUs up to 4474 bytes for SONET interfaces</li></ul>
Software features	<p>For a list of the software features available for services PICs, see the <i>JUNOS Services Interfaces Configuration Guide</i>.</p> <ul style="list-style-type: none"><li>■ Load distribution across multiple PICs</li><li>■ cflowd version 5 support</li><li>■ Provides start and end times of each export</li><li>■ Supports firewall filtering and filter-based forwarding (FBF)</li><li>■ Encapsulations:<ul style="list-style-type: none"><li>■ High-Level Data Link Control (HDLC)</li><li>■ Point-to-Point Protocol (PPP)</li></ul></li></ul>
Cables and connectors	<ul style="list-style-type: none"><li>■ DB-9 diagnostic serial console port</li></ul>
LEDs	<p>Status LED, one tricolor:</p> <ul style="list-style-type: none"><li>■ Off—PIC is offline and it is safe to remove it from the chassis</li><li>■ Green—PIC is operating normally</li><li>■ Amber—PIC is initializing</li><li>■ Red—PIC has an error or failure and no further harm can be done by removing it from the chassis</li></ul> <p>Application LED, one tricolor:</p> <ul style="list-style-type: none"><li>■ Off—Flow collector is not running</li><li>■ Green—Flow collector is running under acceptable load</li><li>■ Amber—Flow collector is overloaded</li></ul>

## Multichannel DS3 PIC

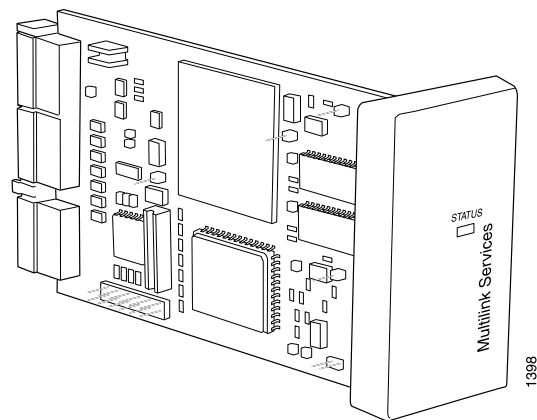


Software release	<ul style="list-style-type: none"> <li>■ JUNOS 5.1 and later</li> </ul>
Description	<ul style="list-style-type: none"> <li>■ Two DS3 ports</li> <li>■ Power requirement: 0.31 A @ 48 V (14.9 W)</li> <li>■ Supports up to 128 logical customer channels per DS3 port</li> </ul>
Hardware features	<ul style="list-style-type: none"> <li>■ Support for NxT1 by interoperating with the Link Services and Multilink Services PICs, using MLPPP and MLFR protocols</li> <li>■ Onboard DSU functionality</li> </ul>
Software features	<ul style="list-style-type: none"> <li>■ Support for four data-link connection identifiers (DLCIs) per logical customer channel</li> <li>■ DS3 alarm and event counting</li> <li>■ DS3 alarm and event detection</li> <li>■ DS3 diagnostics and loopback control</li> <li>■ DS3 framing: M13, C-bit</li> <li>■ T1 framing: super frame (SF) and extended super frame (ESF)</li> <li>■ Encapsulations:               <ul style="list-style-type: none"> <li>■ High-Level Data Link Control (HDLC)</li> <li>■ Frame Relay</li> <li>■ Circuit cross-connect (CCC)</li> <li>■ Point-to-Point Protocol (PPP)</li> </ul> </li> </ul>
Cables and connectors	<ul style="list-style-type: none"> <li>■ Custom 10 ft/3.05 m posilock to BNC male cable, separate Rx and Tx</li> </ul>
LEDs	<p>One tricolor per port:</p> <ul style="list-style-type: none"> <li>■ Off—Not enabled</li> <li>■ Green—Online with no alarms or failures</li> <li>■ Amber—Online with alarms for remote failures</li> <li>■ Red—Active with a local alarm; router has detected a failure</li> </ul>

**Alarms, errors, and events**

- Far-end block error (FEBE)
  - Parity bit (P-bit) disagreements
  - Path priority error
  - Alarm indication signal (AIS)
  - Loss of signal (LOS)
  - Out of frame (OOF)
  - Yellow alarm
  - AIS received
  - Simultaneous BERT functionality
  - Idle received
  - Local and remote loopback
-

Multilink Services PIC



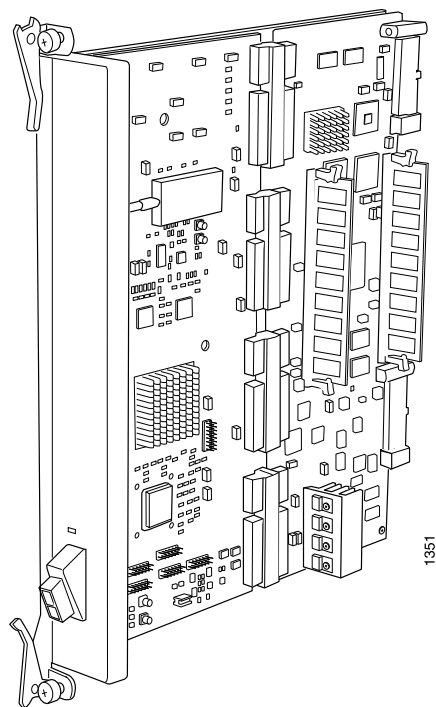
Software release	<ul style="list-style-type: none"><li>■ JUNOS 4.3 and later</li></ul>
Description	<ul style="list-style-type: none"><li>■ Power requirement: 0.17 A/48 V = 8 W</li><li>■ Available versions:<ul style="list-style-type: none"><li>■ 4 multilink bundles</li><li>■ 32 multilink bundles</li><li>■ 128 multilink bundles</li></ul></li><li>■ Can be used as a discrete connection or as a channel</li></ul> <p><b>NOTE:</b> If you configure a unit number larger than the allowable limit on the 4-bundle or 32-bundle Multilink Services PIC, an error will be logged in <code>/var/log/messages</code> and the configuration will fail.</p>
Hardware features	<ul style="list-style-type: none"><li>■ Supports up to eight links per multilink bundle</li><li>■ Bonding T1 links enable service ranging from 1.5 Mbps through 12 Mbps</li><li>■ Bonding E1 links enable service ranging from 2 Mbps through 16 Mbps</li></ul>
Software features	<ul style="list-style-type: none"><li>■ Full configuration flexibility</li><li>■ Bundles can be built from any interface within the chassis</li><li>■ Enables providers to offer a scalable multimegabit access service based on T1 or E1 links</li><li>■ Protocol support:<ul style="list-style-type: none"><li>■ Multilink PPP—MLPPP (RFC 1990) for T1 and E1 bonding</li><li>■ Multilink Frame Relay—MLFR (FRF.15) for T1 and E1 bonding</li></ul></li></ul> <p><b>NOTE:</b> This PIC does not support graceful switchover. Graceful switchover can not be configured on routers that this PIC is installed in.</p>
Cables and connectors	<ul style="list-style-type: none"><li>■ None</li></ul>

**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 OC48c/STM16 PIC (Quad-Wide)**



Software release	<ul style="list-style-type: none"><li>■ JUNOS 4.1 and later</li></ul>
Description	<ul style="list-style-type: none"><li>■ One OC48 port</li><li>■ Power requirements: 0.86 A @ 48 V (41.4 W)</li></ul>
Hardware features	<ul style="list-style-type: none"><li>■ Multiplexing and demultiplexing</li><li>■ Rate policing on input</li><li>■ Rate shaping on output</li><li>■ Packet buffering, Layer 2 parsing</li></ul>
Software features	<ul style="list-style-type: none"><li>■ SONET/SDH framing</li><li>■ Link aggregation</li><li>■ Alarm and event counting and detection</li><li>■ Dual-router automatic protection switching (APS)</li><li>■ Multiprotocol Label Switching (MPLS) fast reroute</li><li>■ Encapsulations:<ul style="list-style-type: none"><li>■ High-Level Data Link Control (HDLC)</li><li>■ Frame Relay</li><li>■ Circuit cross-connect (CCC)</li><li>■ Translational cross-connect (TCC)</li><li>■ Point-to-Point Protocol (PPP)</li></ul></li></ul>

Cables and connectors

- Duplex LC/PC Connector (Rx and Tx)
- Optical interface support—see Table 6 on page 33

**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 6: Optical Interface Support for SONET/SDH OC48c/STM16 PICs**

<b>PIC Type</b>	<b>Single-mode Short Reach (SR)</b>	<b>Single-mode Intermediate Reach (IR)</b>	<b>Single-mode Long Reach (LR)</b>
Optical interface	Single-mode short reach (Telcordia GR-253 compliant) optical interface (maximum distance 1.24 miles/2 km)	Single-mode intermediate reach (Telcordia GR-253 compliant) optical interface (maximum distance 9.3 miles/15 km)	Single-mode long reach (Telcordia GR-253 compliant) optical interface (maximum distance 49.71 miles/80 km); compatible with 1550 nm single-mode LR
Wavelength	1266 through 1360 nm	1260 through 1360 nm	1500 through 1580 nm
Average launch power	-11 through -3 dBm	-5 through 0 dBm	-2 through +3 dBm
Receiver saturation	0 dBm	0 dBm	-9 dBm
Receiver sensitivity	-18 dBm	-18 dBm	-28 dBm

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*M20 Internet Router PIC Guide: End-of-Life PICs*

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#### Revision History

29 June 2007—Revision 7. Removed Adaptive Services II PIC.

30 March 2007—Revision 6. Added Adaptive Services, Monitoring Services, and Multichannel DS3 PICs.

15 January 2005—Revision 5. Added Gigabit Ethernet PIC. Updated information about installing combinations of PICs on a single Enhanced FPC.

9 November 2004—Revision 4.

17 May 2004—Revision 3.

16 March 2004—Revision 2.

5 January 2004—Revision 1.

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.