

T640 Core Router Interface Module Reference



Modified: 2017-05-02

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T640 Core Router Interface Module Reference

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Table of Contents

	About the Documentation	xiii
	Documentation and Release Notes	xiii
	Supported Platforms	xiii
	Documentation Conventions	xiii
	Documentation Feedback	xv
	Requesting Technical Support	xvi
	Self-Help Online Tools and Resources	xvi
	Opening a Case with JTAC	xvi
Part 1	Overview	
Chapter 1	T640 Interface Modules Support	3
	T640 PICs Supported	3
	T640 End-of-Life PICs Supported	10
	T640 PIC/FPC Compatibility	12
	PIC/FPC Compatibility (Type 1 FPCs and Type 1 PICs)	12
	PIC/FPC Compatibility (Type 2 FPCs and Type 2 PICs)	13
	PIC/FPC Compatibility (Type 3 FPCs and Type 3 PICs)	15
	PIC/FPC Compatibility (Type 4 FPCs and Type 4 PICs)	16
Chapter 2	Network Interface Specifications	19
	Supported Network Interface Standards by Transceiver for ACX Series, M Series, MX Series, and T Series Routers	19
	Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications	28
	Fast Ethernet 100BASE-BX Bidirectional SFP Optical Interface Specifications	29
	Gigabit Ethernet 1000BASE-BX Bidirectional SFP (U 13/14 and D 14/13) Optical Interface Specifications	30
	Gigabit Ethernet 1000BASE-BX Bidirectional SFP (U 13/15 and D 15/13) Optical Interface Specifications	30
	Gigabit Ethernet 1000BASE-BX Bidirectional SFP (40 U 13/15 and D 15/13) Optical Interface Specifications	31
	Gigabit Ethernet 1000BASE Optical Interface Specifications	32
	Gigabit Ethernet 1000BASE-SX Optical Interface Specifications	32
	Gigabit Ethernet 1000BASE-LX Optical Interface Specifications	33
	Gigabit Ethernet 1000BASE-LX10 Optical Interface Specifications	33
	Gigabit Ethernet 1000BASE-EX Optical Interface Specifications	34
	Gigabit Ethernet 1000BASE-LH Optical Interface Specifications	35
	Gigabit Ethernet 1000BASE-T Copper Interface Specifications	35

10-Gigabit Ethernet 10GBASE Optical Interface Specifications	36
10GBASE-LRM Specifications	36
10GBASE-S Specifications	37
10GBASE-L Specifications	38
10GBASE-E Specifications	38
10GBASE-Z Specifications	39
10-Gigabit Ethernet DWDM Optical Interface Specifications	41
10-Gigabit Ethernet DWDM Transceiver Wavelengths	41
40-Gigabit Ethernet 40GBASE-R Optical Interface Specifications	43
40GBASE-SR4 Specifications	43
40GBASE-LX4 Specifications	44
40GBASE-LR4 Specifications	45
40GBASE-ER4 Specifications	45
SONET/SDH OC3/STM1 Optical Interface Specifications	46
SONET/SDH OC3/STM1 Specifications	46
SONET/SDH OC3/STM1 Intermediate Reach (IR-1) Specifications	47
SONET/SDH OC3/STM1 Long Reach (LR-1) Specifications	47
SONET/SDH OC12/STM4 Optical Interface Specifications	48
SONET/SDH OC12/STM4 Short Reach (SR-1) Specifications	48
SONET/SDH OC12/STM4 Intermediate Reach (IR-1) Specifications	49
SONET/SDH OC12/STM4 Long Reach (LR-1) Specifications	49
SONET/SDH OC12/STM4 Long Reach (LR-2) Specifications	50
SONET/SDH OC48/STM16 Optical Interface Specifications	51
SONET/SDH OC48/STM16 Short Reach (SR-1) Specifications	51
SONET/SDH OC48/STM16 Intermediate Reach (IR-1) Specifications	51
SONET/SDH OC48/STM16 Long Reach (LR-1) Specifications	52
SONET/SDH OC48/STM16 Long Reach (LR-2) Specifications	52
SONET/SDH OC192/STM64 Optical Interface Specifications	53
SONET/SDH OC192/STM64 Very Short Reach (VSR)	53
SONET/SDH OC192/STM64 Short Reach (SR-1)	54
SONET/SDH OC192/STM64 Short Reach (SR-2)	54
SONET/SDH OC192/STM64 Intermediate Reach (IR-2)	55
SONET/SDH OC192/STM64 Long reach (LR-1)	55
SONET/SDH OC192/STM64 Long reach (LR-2)	56
SONET/SDH OC768/STM256 Optical Interface Specifications	57
 Part 2	 PIC Descriptions
 Chapter 3	 ATM2 IQ PIC Descriptions 61
	ATM2 E3 IQ PIC (T640 Router) 61
	ATM2 OC3/STM1 IQ PIC (T640 Router) 63
	ATM2 OC12/STM4 IQ PICs (T640 Router) 66
	ATM2 OC48/STM16 IQ PIC with SFP (T640 Router) 69
 Chapter 4	 Channelized IQ PIC Descriptions 73
	Channelized DS3 IQ PIC (T640 Router) 73
	Channelized OC3 IQ PIC (T640 Router) 75
	Channelized STM1 IQ PIC (T640 Router) 77

Chapter 5	Channelized Enhanced IQ (IQE) PIC Descriptions	79
	Channelized DS3/E3 Enhanced IQ (IQE) PIC (T640 Router)	80
	Channelized E1/T1 Enhanced IQ (IQE) PIC (T640 Router)	83
	Channelized OC3/STM1 Enhanced IQ (IQE) PIC with SFP (T640 Router)	86
	Channelized OC12/STM4 Enhanced IQ (IQE) PICs with SFP (T640 Router)	91
	Channelized OC48/STM16 Enhanced IQ (IQE) PIC with SFP (T640 Router)	96
Chapter 6	DS3 and E3 PIC Descriptions	101
	DS3/E3 Enhanced IQ (IQE) PIC (T640 Router)	101
	E3 IQ PIC (T640 Router)	104
Chapter 7	Fast Ethernet and Gigabit Ethernet PIC Descriptions	107
	Fast Ethernet PIC (T640 Router)	107
	Gigabit Ethernet PICs with SFP (T640 Router)	109
Chapter 8	Ethernet IQ PIC Descriptions	113
	Gigabit Ethernet IQ PICs with SFP (T640 Router)	113
Chapter 9	Ethernet IQ2 PIC Descriptions	117
	Gigabit Ethernet IQ2 PICs with SFP (T640 Router)	117
	10-Gigabit Ethernet IQ2 PIC with XFP (T640 Router)	120
Chapter 10	Ethernet Enhanced IQ2 (IQ2E) PIC Descriptions	123
	Gigabit Ethernet Enhanced IQ2 (IQ2E) PICs with SFP (T640 Router)	123
	10-Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with XFP (T640 Router)	126
Chapter 11	10-Gigabit Ethernet PIC Descriptions	129
	10-Gigabit Ethernet PIC with XENPAK (T640 Router)	129
	10-Gigabit Ethernet DWDM PIC (T640 Router)	131
	10-Gigabit Ethernet DWDM OTN PIC (T640 Router)	133
	10-Gigabit Ethernet LAN/WAN PIC with SFP+ (T640 Router)	134
	10-Gigabit Ethernet LAN/WAN PIC with XFP (T640 Router)	137
Chapter 12	40-Gigabit Ethernet PIC Descriptions	141
	40-Gigabit Ethernet PIC with CFP (T640 Router)	141
Chapter 13	Services PIC Descriptions	145
	MultiServices PICs (T640 Router)	145
	Tunnel Services PIC (T640 Router)	149
	40-Gigabit Tunnel Services PIC (T640 Router)	150
Chapter 14	SONET/SDH PIC Descriptions	153
	SONET/SDH OC3/STM1 Enhanced IQ (IQE) PIC with SFP (T640 Router)	154
	SONET/SDH OC3/STM1 (Multi-Rate) PICs with SFP (T640 Router)	157
	SONET/SDH OC12/STM4 Enhanced IQ (IQE) PIC with SFP (T640 Router)	160
	SONET/SDH OC12/STM4 (Multi-Rate) PICs with SFP (T640 Router)	163
	SONET/SDH OC48c/STM16 PIC with SFP (T640 Router)	166
	SONET/SDH OC48/STM16 Enhanced IQ (IQE) PIC with SFP (T640 Router)	169
	SONET/SDH OC48/STM16 (Multi-Rate) PIC with SFP (T640 Router)	173
	SONET/SDH OC192c/STM64 PIC (T640 Router)	176
	SONET/SDH OC192c/STM64 PICs with XFP (T640 Router)	179
	SONET/SDH OC768c/STM256 PIC (T640 Router)	182

Chapter 15	End-of-Life PIC Descriptions	185
	ATM OC3 EOL PIC (T640 Router)	186
	ATM OC12 EOL PIC (T640 Router)	187
	Channelized OC12 IQ EOL PIC (T640 Router)	189
	DS3 EOL PIC (T640 Router)	192
	Gigabit Ethernet EOL PICs (T640 Router)	193
	10-Gigabit Ethernet EOL PIC (T640 Router)	195
	Adaptive Services II EOL PIC (T640 Router)	196
	Adaptive Services II Layer 2 Services EOL PIC (T640 Router)	199
	Link Services EOL PIC (T640 Router)	201
	Monitoring Services II EOL PIC (T640 Router)	202
	Monitoring Services III EOL PIC (T640 Router)	204
	SONET/SDH OC3c/STM1 EOL PICs (T640 Router)	205
	SONET/SDH OC12c/STM4 EOL PICs (T640 Router)	208
	SONET/SDH OC48c/STM16 EOL PICs (T640 Router)	211
	SONET/SDH OC48c/STM16 EOL PIC with SFP (T640 Router)	214
	SONET/SDH OC192c/STM64 EOL PICs (T640 Router)	217

List of Figures

Part 2	PIC Descriptions	
Chapter 3	ATM2 IQ PIC Descriptions	61
	Figure 1: 1-Port ATM2 OC12/STM4 IQ PIC	66
	Figure 2: 2-Port ATM2 OC12/STM4 IQ PIC	66
Chapter 5	Channelized Enhanced IQ (IQE) PIC Descriptions	79
	Figure 3: 1-Port IQE PIC	91
	Figure 4: 4-Port IQE PIC (Type 2)	91
	Figure 5: 4-Port IQE PIC (Type 3)	91
Chapter 7	Fast Ethernet and Gigabit Ethernet PIC Descriptions	107
	Figure 6: 1-Port Gigabit Ethernet PIC	109
	Figure 7: 2-Port Gigabit Ethernet PIC	109
	Figure 8: 4-Port Gigabit Ethernet PIC	109
	Figure 9: 10-Port Gigabit Ethernet PIC	109
Chapter 8	Ethernet IQ PIC Descriptions	113
	Figure 10: 1-Port Gigabit Ethernet IQ PIC	113
	Figure 11: 2-Port Gigabit Ethernet IQ PIC	113
Chapter 9	Ethernet IQ2 PIC Descriptions	117
	Figure 12: 4-Port Gigabit Ethernet IQ2 PIC (Type 1)	117
	Figure 13: 8-Port Gigabit Ethernet IQ2 PIC (Type 2)	117
	Figure 14: 8-Port Gigabit Ethernet IQ2 PIC (Type 3)	118
Chapter 10	Ethernet Enhanced IQ2 (IQ2E) PIC Descriptions	123
	Figure 15: 4-Port Gigabit Ethernet IQ2E PIC (Type 1)	123
	Figure 16: 8-Port Gigabit Ethernet IQ2E PIC (Type 2)	123
	Figure 17: 8-Port Gigabit Ethernet IQ2E PIC (Type 3)	124
Chapter 13	Services PIC Descriptions	145
	Figure 18: MultiServices 100 PIC	145
	Figure 19: MultiServices 400 PIC	145
	Figure 20: Center: MultiServices 500 PIC	146
Chapter 14	SONET/SDH PIC Descriptions	153
	Figure 21: SONET/SDH OC3/STM1 (Multi-Rate) PIC (Type 1)	157
	Figure 22: SONET/SDH OC3/STM1 (Multi-Rate) PIC (Type 2)	157
	Figure 23: 1-Port SONET/SDH OC12/STM4 (Multi-Rate) PIC	163
	Figure 24: 4-Port SONET/SDH OC12/STM4 (Multi-Rate) PIC	163
	Figure 25: 1-Port SONET/SDH OC192c/STM64 PIC	179
	Figure 26: 4-Port SONET/SDH OC192c/STM64 PIC	179

Chapter 15	End-of-Life PIC Descriptions	185
	Figure 27: 2-Port Gigabit Ethernet PIC	193
	Figure 28: 4-Port Gigabit Ethernet PIC	193
	Figure 29: SONET/SDH OC3c/STM1 PIC (MMF)	205
	Figure 30: SONET/SDH OC3c/STM1 PIC (SMF-IR)	205
	Figure 31: 1-Port SONET/SDH OC12c/STM4 PIC	208
	Figure 32: 4-Port SONET/SDH OC12c/STM4 PIC	208
	Figure 33: 1-Port SONET/SDH OC48c/STM16 PIC	211
	Figure 34: 4-Port SONET/SDH OC48c/STM16 PIC	211

List of Tables

	About the Documentation	xiii
	Table 1: Notice Icons	xiv
	Table 2: Text and Syntax Conventions	xiv
Part 1	Overview	
Chapter 1	T640 Interface Modules Support	3
	Table 3: PICs Supported in the T640 Router	3
	Table 4: End-of-Life PICs Supported in the T640 Router	10
	Table 5: T640 PIC/FPC Compatibility Type 1	12
	Table 6: T640 PIC/FPC Compatibility Type 2	14
	Table 7: T640 PIC/FPC Compatibility Type 3	15
	Table 8: T640 PIC/FPC Compatibility Type 4	17
Chapter 2	Network Interface Specifications	19
	Table 9: Supported Ethernet Standards	20
	Table 10: Supported SONET Standards	27
	Table 11: Fast Ethernet 100BASE-BX Bidirectional SFP Optical Interface Specifications	29
	Table 12: Gigabit Ethernet 1000BASE-BX Bidirectional SFP (U13/14 and D14/13) Optical Interface Specifications	30
	Table 13: Gigabit Ethernet 1000BASE-BX Bidirectional SFP (U13/15 and D15/13) Optical Interface Specifications	30
	Table 14: Gigabit Ethernet 1000BASE-BX Bidirectional SFP (40 U13/15 and D 15/13) Optical Interface Specifications	31
	Table 15: Gigabit Ethernet 1000BASE-SX Optical Interface Specifications	32
	Table 16: Gigabit Ethernet 1000BASE-LX Optical Interface Specifications	33
	Table 17: Gigabit Ethernet 1000BASE-LX10 Optical Interface Specifications	34
	Table 18: Gigabit Ethernet 1000BASE-EX Optical Interface Specifications	34
	Table 19: Gigabit Ethernet 1000BASE-LH Optical Interface Specifications	35
	Table 20: 1000BASE-T Copper Interface Specifications	35
	Table 21: 10GBASE-LRM Optical Interface Specifications	36
	Table 22: 10GBASE-S (10GBASE-SR and 10GBASE-SW) Optical Interface Specifications	37
	Table 23: 10GBASE-L (10GBASE-LR and 10GBASE-LW) Optical Interface Specifications	38
	Table 24: 10GBASE-E (10GBASE-ER and 10GBASE-EW) Optical Interface Specifications	38
	Table 25: 10GBASE-Z (10GBASE-ZR and 10GBASE-ZW) Optical Interface Specifications	39

Table 26: 10-Gigabit Ethernet DWDM LAN Rate Optical Interface Specifications	41
Table 27: Programmable Wavelengths Supported by 10-Gigabit Ethernet DWDM Transceivers	42
Table 28: 40GBASE-SR4 Optical Interface Specifications	43
Table 29: 40GBASE-LX4 Optical Interface Specifications	44
Table 30: 40GBASE-LR4 Optical Interface Specifications	45
Table 31: 40GBASE-ER4 Optical Interface Specifications	46
Table 32: SONET/SDH OC3/STM1 Multimode Optical Interface Specifications	47
Table 33: SONET/SDH OC3/STM1 Intermediate Reach Optical Interface Specifications	47
Table 34: SONET/SDH OC3/STM1 Long Reach -1 Optical Interface Specifications	48
Table 35: SONET/SDH OC12/STM4 Short Reach (SR-1) Optical Interface Specifications	49
Table 36: SONET/SDH OC12/STM4 Intermediate Reach (IR-1) Optical Interface Specifications	49
Table 37: SONET/SDH OC12/STM4 Long Reach (LR-1) Optical Interface Specifications	50
Table 38: SONET/SDH OC12/STM4 Long Reach (LR-2) Optical Interface Specifications	50
Table 39: SONET/SDH OC48/STM16 Short Reach (SR-1) Optical Interface Specifications	51
Table 40: SONET/SDH OC48/STM16 Intermediate Reach (IR-1) Optical Interface Specifications	52
Table 41: SONET/SDH OC48/STM16 Long Reach (LR-1) Optical Interface Specifications	52
Table 42: SONET/SDH OC48/STM16 Long Reach (LR-2) Optical Interface Specifications	53
Table 43: SONET/SDH OC192/STM64 Very Short Reach (VSR1) Optical Interface Specifications	54
Table 44: SONET/SDH OC192/STM64 Short Reach (SR-1) Optical Interface Specifications	54
Table 45: SONET/SDH OC192/STM64 Short Reach (SR-2) Optical Interface Specifications	55
Table 46: SONET/SDH OC192/STM64 Intermediate Reach (IR-2) Optical Interface Specifications	55
Table 47: SONET/SDH OC192/STM64 Long Reach (LR-1) Optical Interface Specifications	56
Table 48: SONET/SDH OC192/STM64 Long Reach (LR-2) Optical Interface Specifications	56
Table 49: SONET/SDH OC768/STM256 Short Reach (SR-1) Optical Interface Specifications	57

Part 2

Chapter 5

PIC Descriptions

Channelized Enhanced IQ (IQE) PIC Descriptions 79

	Table 50: PICs Supported in Fourth Slot of T640-FPC2-E and T640-FPC2-E2 with Type 2 IQE PICs	100
Chapter 13	Services PIC Descriptions	145
	Table 51: MultiServices PICs Software Features Supported on the T640 Router	147
Chapter 15	End-of-Life PIC Descriptions	185
	Table 52: Adaptive Services PICs Software Features	197
	Table 53: Adaptive Services PICs Software Features	199

About the Documentation

- Documentation and Release Notes on page xiii
- Supported Platforms on page xiii
- Documentation Conventions on page xiii
- Documentation Feedback on page xv
- Requesting Technical Support on page xvi

Documentation and Release Notes

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Supported Platforms

For the features described in this document, the following platforms are supported:

- T640

Documentation Conventions

Table 1 on page xiv defines notice icons used in this guide.

Table 1: Notice Icons

Icon	Meaning	Description
	Informational note	Indicates important features or instructions.
	Caution	Indicates a situation that might result in loss of data or hardware damage.
	Warning	Alerts you to the risk of personal injury or death.
	Laser warning	Alerts you to the risk of personal injury from a laser.
	Tip	Indicates helpful information.
	Best practice	Alerts you to a recommended use or implementation.

Table 2 on page xiv defines the text and syntax conventions used in this guide.

Table 2: Text and Syntax Conventions

Convention	Description	Examples
Bold text like this	Represents text that you type.	To enter configuration mode, type the configure command: user@host> configure
Fixed-width text like this	Represents output that appears on the terminal screen.	user@host> show chassis alarms No alarms currently active
<i>Italic text like this</i>	- Introduces or emphasizes important new terms. - Identifies guide names. - Identifies RFC and Internet draft titles.	- A policy <i>term</i> is a named structure that defines match conditions and actions. <i>Junos OS CLI User Guide</i> - RFC 1997, <i>BGP Communities Attribute</i>
<i>Italic text like this</i>	Represents variables (options for which you substitute a value) in commands or configuration statements.	Configure the machine's domain name: [edit] root@# set system domain-name <i>domain-name</i>

Table 2: Text and Syntax Conventions (*continued*)

Convention	Description	Examples
Text like this	Represents names of configuration statements, commands, files, and directories; configuration hierarchy levels; or labels on routing platform components.	- To configure a stub area, include the stub statement at the [edit protocols ospf area area-id] hierarchy level. - The console port is labeled CONSOLE.
< > (angle brackets)	Encloses optional keywords or variables.	stub <default-metric <i>metric</i>>;
(pipe symbol)	Indicates a choice between the mutually exclusive keywords or variables on either side of the symbol. The set of choices is often enclosed in parentheses for clarity.	broadcast multicast (<i>string1</i> <i>string2</i> <i>string3</i>)
# (pound sign)	Indicates a comment specified on the same line as the configuration statement to which it applies.	rsvp { # Required for dynamic MPLS only
[] (square brackets)	Encloses a variable for which you can substitute one or more values.	community name members [<i>community-ids</i>]
Indentation and braces ({ })	Identifies a level in the configuration hierarchy.	<pre>[edit] routing-options { static { route default { nexthop <i>address</i>; retain; } } }</pre>
;(semicolon)	Identifies a leaf statement at a configuration hierarchy level.	
GUI Conventions		
Bold text like this	Represents graphical user interface (GUI) items you click or select.	- In the Logical Interfaces box, select All Interfaces. - To cancel the configuration, click Cancel.
> (bold right angle bracket)	Separates levels in a hierarchy of menu selections.	In the configuration editor hierarchy, select Protocols>Ospf .

Documentation Feedback

We encourage you to provide feedback, comments, and suggestions so that we can improve the documentation. You can provide feedback by using either of the following methods:

- Online feedback rating system—On any page of the Juniper Networks TechLibrary site at <http://www.juniper.net/techpubs/index.html>, simply click the stars to rate the content, and use the pop-up form to provide us with information about your experience. Alternately, you can use the online feedback form at <http://www.juniper.net/techpubs/feedback/>.

- E-mail—Send your comments to techpubs-comments@juniper.net. Include the document or topic name, URL or page number, and software version (if applicable).

Requesting Technical Support

Technical product support is available through the Juniper Networks Technical Assistance Center (JTAC). If you are a customer with an active J-Care or Partner Support Service support contract, or are covered under warranty, and need post-sales technical support, you can access our tools and resources online or open a case with JTAC.

- JTAC policies—For a complete understanding of our JTAC procedures and policies, review the *JTAC User Guide* located at <http://www.juniper.net/us/en/local/pdf/resource-guides/7100059-en.pdf>.
- Product warranties—For product warranty information, visit <http://www.juniper.net/support/warranty/>.
- JTAC hours of operation—The JTAC centers have resources available 24 hours a day, 7 days a week, 365 days a year.

Self-Help Online Tools and Resources

For quick and easy problem resolution, Juniper Networks has designed an online self-service portal called the Customer Support Center (CSC) that provides you with the following features:

- Find CSC offerings: <http://www.juniper.net/customers/support/>
- Search for known bugs: <http://www2.juniper.net/kb/>
- Find product documentation: <http://www.juniper.net/techpubs/>
- Find solutions and answer questions using our Knowledge Base: <http://kb.juniper.net/>
- Download the latest versions of software and review release notes: <http://www.juniper.net/customers/csc/software/>
- Search technical bulletins for relevant hardware and software notifications: <http://kb.juniper.net/InfoCenter/>
- Join and participate in the Juniper Networks Community Forum: <http://www.juniper.net/company/communities/>
- Open a case online in the CSC Case Management tool: <http://www.juniper.net/cm/>

To verify service entitlement by product serial number, use our Serial Number Entitlement (SNE) Tool: <https://tools.juniper.net/SerialNumberEntitlementSearch/>

Opening a Case with JTAC

You can open a case with JTAC on the Web or by telephone.

- Use the Case Management tool in the CSC at <http://www.juniper.net/cm/>.
- Call 1-888-314-JTAC (1-888-314-5822 toll-free in the USA, Canada, and Mexico).

For international or direct-dial options in countries without toll-free numbers, see <http://www.juniper.net/support/requesting-support.html>.

PART 1

Overview

- [T640 Interface Modules Support on page 3](#)
- [Network Interface Specifications on page 19](#)

CHAPTER 1

T640 Interface Modules Support

- [T640 PICs Supported on page 3](#)
- [T640 End-of-Life PICs Supported on page 10](#)
- [T640 PIC/FPC Compatibility on page 12](#)

T640 PICs Supported

[Table 3 on page 3](#) lists the PICs supported by the T640 router. The PICs are listed alphabetically by PIC family.

Table 3: PICs Supported in the T640 Router

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
ATM2 IQ				
“ATM2 E3 IQ PIC (T640 Router)” on page 61	4	PB-2E3-ATM2	Coaxial: • 10 ft (3.05 m) posilock SMB to BNC cable (provided) • Four pairs of Rx and Tx coaxial cables	7.4
“ATM2 OC3/STM1 IQ PIC (T640 Router)” on page 63	2	PB-2OC3-ATM2-MM PB-2OC3-ATM2-SMIR	• Optical: SC/PC	7.6
“ATM2 OC12/STM4 IQ PICs (T640 Router)” on page 66				
• ATM2 OC12/STM4 IQ PIC	2	PB-2OC12-ATM2-MM PB-2OC12-ATM2-SMIR	• Optical: SC/PC	5.5
• ATM2 OC12/STM4 IQ PIC	1	PB-1OC12-ATM2-MM PB-1OC12-ATM2-SMIR	• Optical: SC/PC	8.0
“ATM2 OC48/STM16 IQ PIC with SFP (T640 Router)” on page 69	1	PB-1OC48-ATM2-SFP	• Optical: LC/PC	7.3
Channelized IQ				

Table 3: PICs Supported in the T640 Router (*continued*)

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
"Channelized DS3 IQ PIC (T640 Router)" on page 73	4	PB-4CHDS3-QPP	Coaxial Standard DS3 BNC coaxial cable interfaces	8.0
"Channelized OC3 IQ PIC (T640 Router)" on page 75	1	PB-1CHOC3-SMIR-QPP	Optical: SC/PC	7.6
"Channelized STM1 IQ PIC (T640 Router)" on page 77	1	PB-1CHSTM1-SMIR-QPP	Optical: SC/PC	7.5
Channelized Enhanced IQ (IQE)				
"Channelized DS3/E3 Enhanced IQ (IQE) PIC (T640 Router)" on page 80	4	PB-4CHDS3-E3-IQE-BNC	Coaxial Standard DS3 BNC coaxial cable interfaces	9.3
"Channelized E1/T1 Enhanced IQ (IQE) PIC (T640 Router)" on page 83	10	PB-10CHE1-T1-IQE-RJ48	120-ohm RJ-48C connector (female)	9.5
"Channelized OC3/STM1 Enhanced IQ (IQE) PIC with SFP (T640 Router)" on page 86	2	PB-2CHOC3-STM1-IQE-SFP	Optical: LC/PC	9.3
"Channelized OC12/STM4 Enhanced IQ (IQE) PICs with SFP (T640 Router)" on page 91				
Channelized OC12/STM4 Enhanced IQ (IQE) PIC with SFP	1	PB-1CHOC12-STM4-IQE-SFP	Optical: LC/PC	9.3
Channelized OC12/STM4 Enhanced IQ (IQE) PIC with SFP	4	PB-4CHOC12-STM4-IQE-SFP	Optical: LC/PC	9.4
Channelized OC12/STM4 Enhanced IQ (IQE) PIC with SFP	4	PC-4CHOC12-STM4-IQE-SFP	Optical: LC/PC	10.0R2
"Channelized OC48/STM16 Enhanced IQ (IQE) PIC with SFP (T640 Router)" on page 96	1	PB-1CHOC48-STM16-IQE-SFP	Optical: LC/PC	9.4
DS3/E3 IQ				
"DS3/E3 Enhanced IQ (IQE) PIC (T640 Router)" on page 101	4	PB-4DS3-E3-IQE-BNC	Coaxial Standard DS3 BNC coaxial cable interfaces	9.3R2
"E3 IQ PIC (T640 Router)" on page 104	4	PB-4E3-QPP	Coaxial Standard DS3 BNC coaxial cable interfaces	6.3 (7.3 TX Matrix router)

Table 3: PICs Supported in the T640 Router (*continued*)

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
Fast Ethernet and Gigabit Ethernet				
"Fast Ethernet PIC (T640 Router)" on page 107	4	PB-4FE-TX	• RJ-45 • Two-pair, Category 5 unshielded twisted-pair • Pinout: MDI noncrossover	6.3
"Gigabit Ethernet PICs with SFP (T640 Router)" on page 109				
• Gigabit Ethernet PIC with SFP	1	PB-1GE-SFP	• Optical: LC/PC • Copper: RJ-45 • Four-pair, Category 5 shielded twisted-pair connectivity • Pinout: MDI crossover	8.0
• Gigabit Ethernet PIC with SFP	2	PB-2GE-SFP	• Optical: LC/PC • Copper: RJ-45 • Four-pair, Category 5 shielded twisted-pair connectivity • Pinout: MDI crossover	6.4
• Gigabit Ethernet PIC with SFP	4	PB-4GE-SFP	• Optical: LC/PC • Copper: RJ-45 • Four-pair, Category 5 shielded twisted-pair connectivity • Pinout: MDI crossover	7.0
• Gigabit Ethernet PIC with SFP	10	PC-10GE-SFP	• Optical: LC/PC • Copper: RJ-45 • Four-pair, Category 5 shielded twisted-pair connectivity • Pinout: MDI crossover	5.5

Table 3: PICs Supported in the T640 Router (*continued*)

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
Gigabit Ethernet IQ				
“Gigabit Ethernet IQ PICs with SFP (T640 Router)” on page 113				
• Gigabit Ethernet IQ PIC with SFP	1	PB-1GE-SFP-QPP	- Optical: LC/PC - Copper: RJ-45 - Four-pair, Category 5 shielded twisted-pair connectivity - Pinout: MDI crossover	6.1
• Gigabit Ethernet IQ PIC with SFP	2	PB-2GE-SFP-QPP	- Optical: LC/PC - Copper: RJ-45 - Four-pair, Category 5 shielded twisted-pair connectivity - Pinout: MDI crossover	6.1 (7.3 TX Matrix router)
Gigabit Ethernet IQ2				
“Gigabit Ethernet IQ2 PICs with SFP (T640 Router)” on page 117				
• Gigabit Ethernet IQ2 PIC with SFP	4	PB-4GE-TYPE1-SFP-IQ2	- Optical: LC/PC - Copper: RJ-45 - Four-pair, Category 5 shielded twisted-pair connectivity - Pinout: MDI crossover	7.6R3
• Gigabit Ethernet IQ2 PIC with SFP	8	PB-8GE-TYPE2-SFP-IQ2	- Optical: LC/PC - Copper: RJ-45 - Four-pair, Category 5 shielded twisted-pair connectivity - Pinout: MDI crossover	7.6R2
• Gigabit Ethernet IQ2 PIC with SFP	8	PB-8GE-TYPE3-SFP-IQ2	- Optical: LC/PC - Copper: RJ-45 - Four-pair, Category 5 shielded twisted-pair connectivity - Pinout: MDI crossover	8.2

Table 3: PICs Supported in the T640 Router (*continued*)

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
"10-Gigabit Ethernet IQ2 PIC with XFP (T640 Router)" on page 120	1	PC-1XGE-TYPE3-XFP-IQ2	- Optical: LC/PC - Copper: RJ-45 - Four-pair, Category 5 shielded twisted-pair connectivity - Pinout: MDI crossover	8.0R3
Gigabit Ethernet and 10-Gigabit Ethernet Enhanced IQ2 (IQ2E)				
"Gigabit Ethernet Enhanced IQ2 (IQ2E) PICs with SFP (T640 Router)" on page 123				
Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with SFP	4	PB-4GE-TYPE1-SFP-IQ2E	- Optical: LC/PC - Copper: RJ-45 - Four-pair, Category 5 shielded twisted-pair connectivity - Pinout: MDI crossover	9.4
Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with SFP	8	PB-8GE-TYPE2-SFP-IQ2	- Optical: LC/PC - Copper: RJ-45 - Four-pair, Category 5 shielded twisted-pair connectivity - Pinout: MDI crossover	9.4
"10-Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with XFP (T640 Router)" on page 126	1	PC-1XGE-TYPE3-XFP-IQ2E	- Optical: LC/PC - Copper: RJ-45 - Four-pair, Category 5 shielded twisted-pair connectivity - Pinout: MDI crossover	9.4
10-Gigabit Ethernet				
"10-Gigabit Ethernet PIC with XENPAK (T640 Router)" on page 129				
10-Gigabit Ethernet PIC with XENPAK 10GBASE-ER or 10GBASE-LR transceivers	1	PC-1XGE-XENPAK	XENPAK	6.2
10-Gigabit Ethernet PIC with XENPAK 10GBASE-SR or 10GBASE-ZR transceivers	1	PC-1XGE-XENPAK	XENPAK	7.1

Table 3: PICs Supported in the T640 Router (*continued*)

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
"10-Gigabit Ethernet DWDM PIC (T640 Router)" on page 131	1	PC-1XGE-DWDM-CBAND	• Optical: SC/PC	7.5
"10-Gigabit Ethernet DWDM OTN PIC (T640 Router)" on page 133	1	PC-1XGE-DWDM-OTN	• Optical: SC/PC	9.4
"10-Gigabit Ethernet LAN/WAN PIC with SFP+ (T640 Router)" on page 134	10	PD-5-10XGE-SFPP	• Optical: LC/PC	10.1
"10-Gigabit Ethernet LAN/WAN PIC with XFP (T640 Router)" on page 137	4	PD-4XGE-XFP	• Optical: LC/PC	9.0
40-Gigabit Ethernet				
"40-Gigabit Ethernet PIC with CFP (T640 Router)" on page 141	4	PD-1XLE-CFP	Optical: SC/PC	11.4
Services				
"MultiServices PICs (T640 Router)" on page 145				
• 100 MultiServices PIC	0	PB-MS-100-1	• None	8.1
• 400 MultiServices PIC	0	PB-MS-400-2	• None	8.1R2
• 500 MultiServices PIC	0	PB-MS-500-3	• None	8.3
"Tunnel Services PIC (T640 Router)" on page 149				
• Type 1 Tunnel Services	0	PB-TUNNEL-1	• None	8.0
• Type 2 Tunnel Services	0	PB-TUNNEL	• None	6.1
• Type 3 Tunnel Services	0	PC-TUNNEL	• None	5.3
"40-Gigabit Tunnel Services PIC (T640 Router)" on page 150	0	PD-TUNNEL	• None	8.0
SONET/SDH				
"SONET/SDH OC3/STM1 Enhanced IQ (IQE) PIC with SFP (T640 Router)" on page 154	4	PB-4OC3-STM1-IQE-SFP	• Optical: LC/PC	9.3R2
"SONET/SDH OC3/STM1 (Multi-Rate) PICs with SFP (T640 Router)" on page 157				
• SONET/SDH OC3/STM1 (Multi-Rate) PIC with SFP	4	PB-4OC3-10C12-SON-SFP	• Optical: LC/PC	8.4

Table 3: PICs Supported in the T640 Router (*continued*)

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
• SONET/SDH OC3/STM1 (Multi-Rate) PIC with SFP	4	PB-4OC3-1OC12-SON-SFP	• Optical: LC/PC	8.3
“SONET/SDH OC12/STM4 Enhanced IQ (IQE) PIC with SFP (T640 Router)” on page 160	1	PB-1OC12-STM4-IQE-SFP	• Optical: LC/PC	9.3
“SONET/SDH OC12/STM4 (Multi-Rate) PICs with SFP (T640 Router)” on page 163				
• SONET/SDH OC12/STM4 (Multi-Rate) PIC with SFP	1	PB-1OC12-SON-SFP	• Optical: LC/PC	8.4
• SONET/SDH OC12/STM4 (Multi-Rate) PIC with SFP	4	PB-4OC3-4OC12-SON-SFP	• Optical: LC/PC	8.3
“SONET/SDH OC48c/STM16 PIC with SFP (T640 Router)” on page 166				
• SONET/SDH OC48c/STM16 PIC with SFP	1		• Optical: LC/PC	6.1
• SONET/SDH OC48c/STM16 PIC with SFP	4	PC-4OC48-SON-SFP	• Optical: LC/PC	6.2
“SONET/SDH OC48/STM16 Enhanced IQ (IQE) PIC with SFP (T640 Router)” on page 169	4	PC-4OC48-STM16-IQE-SFP	• Optical: LC/PC	10.4R2
“SONET/SDH OC48/STM16 (Multi-Rate) PIC with SFP (T640 Router)” on page 173	1	PB-1OC48-SON-B-SFP	• Optical: LC/PC	8.3
“SONET/SDH OC192c/STM64 PIC (T640 Router)” on page 176	1	PC-1OC192-SON-VSR	• 12-ribbon multimode fiber with MTP connector	5.3
“SONET/SDH OC192c/STM64 PICs with XFP (T640 Router)” on page 179				
• SONET/SDH OC192c/STM64 PIC with XFP	1	PC-1OC192-SON-XFP	• Optical: LC/PC	8.1
• SONET/SDH OC192c/STM64 PIC with XFP	4	PD-4OC192-SON-XFP	• Optical: LC/PC	8.1
“SONET/SDH OC768c/STM256 PIC (T640 Router)” on page 182	1	PD-1OC768-SON-SR	• Optical: SC/PC	7.5

Related Documentation

- *T640 PIC Description*
- *T640 PIC Combination Limitations*

- [T640 FPCs Supported](#)
- [T640 PIC/FPC Compatibility on page 12](#)

T640 End-of-Life PICs Supported

Table 3 on page 3 lists the end-of-life PICs supported by the T640 router. The PICs are listed alphabetically by PIC family.

Table 4: End-of-Life PICs Supported in the T640 Router

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
ATM				
"ATM OC3 EOL PIC (T640 Router)" on page 186	2	PB-2OC3-ATM-MM PB-2OC3-ATM-SMIR	• Optical: SC/PC	4.0
"ATM OC12 EOL PIC (T640 Router)" on page 187	1	PB-1OC12-ATM-MM PB-1OC12-ATM-SMIR	• Optical: SC/PC	4.0
Channelized IQ				
"Channelized OC12 IQ EOL PIC (T640 Router)" on page 189	1	PB-1CHOC12SMIR-QPP	• Optical: SC/PC	6.3
DS3				
"DS3 EOL PIC (T640 Router)" on page 192	4	PB-2DS3	• Custom 10 ft (3.05 m) posilock SMB to BNC male cable, separate Rx and Tx (provided)	6.3
Ethernet				
"Gigabit Ethernet EOL PICs (T640 Router)" on page 193				
• Gigabit Ethernet PIC	2	PB-2GE-LX PB-2GE-SX	• Optical: SC/PC	5.3
• Gigabit Ethernet PIC	4	PB-4GE-SX	• Optical: SC/PC	5.3
"10-Gigabit Ethernet EOL PIC (T640 Router)" on page 195	1	PC-1XGE-LR	• Optical: SC/PC	5.4
Services				
"Adaptive Services II EOL PIC (T640 Router)" on page 196	0	PB-AS2	• None	6.4 (7.3 TX Matrix platform)
"Adaptive Services II Layer 2 Services EOL PIC (T640 Router)" on page 199	0	PB-AS2-LAYER2SERVICES	• None	7.5

Table 4: End-of-Life PICs Supported in the T640 Router (*continued*)

PIC Family and Type	Ports	Model Number	Connector	First Junos OS Release Support
"Link Services EOL PIC (T640 Router)" on page 201	0	PB-LS-4 PB-LS-32 PB-LS-128	• None	6.1
"Monitoring Services II EOL PIC (T640 Router)" on page 202	0	PB-PM2	• None	7.1R2
"Monitoring Services III EOL PIC (T640 Router)" on page 204	0	PB-PM3	• None	7.4
SONET/SDH				
"SONET/SDH OC3c/STM1 EOL PICs (T640 Router)" on page 205				
• SONET/SDH OC3c/STM1 PIC	4	PB-4OC3-SON-MM PB-4OC3-SON-SMIR	• Optical: SC/PC	5.5
• SONET/SDH OC3c/STM1 PIC	4	PB-4OC3-SON-MM PB-4OC3-SON-SMIR	• Optical: SC/PC	7.1
"SONET/SDH OC12c/STM4 EOL PICs (T640 Router)" on page 208				
• SONET/SDH OC12c/STM4 PIC	1	PB-1OC12-SON-MM	• Optical: SC/PC	7.1
• SONET/SDH OC12c/STM4 PIC	4	PB-4OC12-SON-MM PB-4OC12-SON-SMIR	• Optical: SC/PC	5.3
• SONET/SDH OC12c/STM4 PIC	4	PB-4OC12-SON-MM PB-4OC12-SON-SMIR	• Optical: SC/PC	5.5
"SONET/SDH OC48c/STM16 EOL PICs (T640 Router)" on page 211				
• SONET/SDH OC48c/STM16 PIC	1	PB-1OC48-SON-SMLR PB-1OC48-SON-SMSR	• Optical: SC/PC	5.3
• SONET/SDH OC48c/STM16 PIC	4	PC-4OC48-SON-SMSR	• Optical: SC/PC	5.3
"SONET/SDH OC48c/STM16 EOL PIC with SFP (T640 Router)" on page 214	1	PB-1OC48-SON-SFP	• Optical: LC/PC	6.1
"SONET/SDH OC192c/STM64 EOL PICs (T640 Router)" on page 217	1	PC-1OC192-SON-LR PC-1OC192-SON-SR2	• Optical: SC/PC	5.4

Related Documentation

- [T640 PIC Description](#)

T640 PIC/FPC Compatibility

The PIC/FPC compatibility matrix lists the current PICs for T640 routers, both standalone and connected to a T640 Matrix router unless otherwise noted, and the first Junos OS Release in which the FPC supports the PIC. For example, Junos 7.6 is the first release in which the T640-FPC1-E2 supports the ATM2 OC3/STM1 IQ, 2-port PIC.

- [PIC/FPC Compatibility \(Type 1 FPCs and Type 1 PICs\) on page 12](#)
- [PIC/FPC Compatibility \(Type 2 FPCs and Type 2 PICs\) on page 13](#)
- [PIC/FPC Compatibility \(Type 3 FPCs and Type 3 PICs\) on page 15](#)
- [PIC/FPC Compatibility \(Type 4 FPCs and Type 4 PICs\) on page 16](#)

PIC/FPC Compatibility (Type 1 FPCs and Type 1 PICs)

[Table 5 on page 12](#) provides a PIC/FPC compatibility matrix for the current Type 1 PICs for the T640 router and Type 1 FPCs.

Table 5: T640 PIC/FPC Compatibility Type 1

PIC	PIC Model Number	T640-FPC1-E	T640-FPC1-E2	T640-FPC1-ES
ATM2 IQ PICs				
ATM2 E3 IQ, 4-port	PB-4E3-ATM2	7.4	7.4	–
ATM2 OC3/STM1 IQ, 2-port	PB-2OC3-ATM2-MM	7.6	7.6	–
	PB-2OC3-ATM2-SMIR			
ATM2 OC12/ STM4 IQ, 1-port	PB-1OC12-ATM2-MM	8.0	8.0	–
	PB-1OC12-ATM2-SMIR			
Channelized IQ PICs				
ChDS3 IQ, 4-port	PB-4CHDS3-QPP	8.0	8.0	9.4
ChOC3 IQ, 1-port	PB-1CHOC3-SMIR-QPP	7.6	7.6	9.4
ChSTM1 IQ, 1-port	PB-1CHSTM1-SMIR-QPP	7.5	7.5	9.4
Channelized IQE PICs				
ChDS3/E3 IQE, 4-port	PB-4CHDS3-E3-IQE-BNC	9.3R2	9.3R2	9.4
ChE1/T1 IQE, 10-port	PB-1OCHE1-T1-IQE-RJ48	9.5	9.5	9.5
ChOC3/STM1 IQE, 2-port	PB-2CHOC3-STM1-IQE-SFP	9.3	9.3	9.4
ChOC12/STM4 IQE, 1-port	PB-1CHOC12-STM4-IQE-SFP	9.3	9.3	9.4

Table 5: T640 PIC/FPC Compatibility Type 1 (*continued*)

PIC	PIC Model Number	T640-FPC1-E	T640-FPC1-E2	T640-FPC1-ES
TI, DS3, E1, E3 PICs				
DS3, 4-port	PB-4DS3	6.2	–	–
E3 IQ, 4-port	PB-4E3-QPP	8.5	8.5	–
Fast Ethernet and Gigabit Ethernet PICs				
Fast Ethernet, 4-port	PB-4FE-TX	6.3	7.4	9.4
Gigabit Ethernet, 1-port SFP	PB-1GE-SFP	8.0	8.0	9.4
Gigabit Ethernet IQ PICs				
Gigabit Ethernet IQ, 1-port SFP	PB-1GE-SFP-QPP	8.0	8.0	–
Gigabit Ethernet IQ2 PICs				
Gigabit Ethernet IQ2, 4-port SFP	PB-4GE-TYPE1-SFP-IQ2	7.6R3	7.6R3	9.4
Gigabit Ethernet IQ2E PICs				
Gigabit Ethernet IQ2E, 4-port SFP	PB-4GE-TYPE1-SFP-IQ2E	9.4	9.4	–
Services PICs				
MultiServices 100	PB-MS-100-1	8.1	8.1	9.4
Tunnel Services	PB-TUNNEL1	8.0	8.0	9.4
SONET/SDH PICs				
OC3/STM1 IQE, 4-port SFP	PB-4OC3-STM1-IQE-SFP	9.3R2	9.3R2	–
OC3c/STM1 (Multi-Rate), 4-port (Type 1)	PB-4OC3-1OC12-SON-SFP	8.4	8.4	9.4
OC12/STM4 IQE, 1-port SFP	PB-1OC12-STM4-IQE-SFP	9.3	9.3	–
OC12c/STM4 (Multi-Rate), 1-port (Type 1)	PB-1OC12-SON-SFP	8.4	8.4	9.4

PIC/FPC Compatibility (Type 2 FPCs and Type 2 PICs)

Table 6 on page 14 provides a PIC/FPC compatibility matrix for the current Type 2 PICs for the T640 router and Type 2 FPCs.

Table 6: T640 PIC/FPC Compatibility Type 2

PIC	PIC Model Number	T640-FPC2	T640-FPC2-E	T640-FPC2-E2	T640-FPC2-ES
ATM2 IQ PICs					
ATM2 OC12/ STM4 IQ, 1-port	PB-IOC12-ATM2-MM PB-IOC12-ATM2-SMIR	5.5	6.3	7.4	—
ATM2 OC48/ STM16 IQ, 1-port SFP	PB-IOC48-ATM2-SFP	7.3	7.3	7.4	—
Channelized IQE PICs					
ChOC12/STM4 IQE, 4-port	PB-4CHOC12-STM4-IQE-SFP	—	9.4	9.4	9.5
ChOC48/STM16 IQE, 1-port	PB-1CHOC48-STM16-IQE-SFP	—	9.4	9.4	9.5
Gigabit Ethernet PICs					
Gigabit Ethernet, 2-port SFP	PB-2GE-SFP	6.4	6.4	7.4	9.5
Gigabit Ethernet, 4-port SFP	PB-4GE-SFP	7.0	7.0	7.4	9.5
Gigabit Ethernet IQ PICs					
Gigabit Ethernet IQ, 2-port SFP	PB-2GE-SFP-QPP in a standalone T640 router	6.1	6.3	7.4	—
	PB-2GE-SFP-QPP in a T640 router connected to a TX Matrix router	7.3	7.3	7.4	—
Gigabit Ethernet IQ2 PICs					
Gigabit Ethernet IQ2, 8-port SFP (Type 2)	PB-8GE-TYPE2-SFP-IQ2	—	7.6R2	7.6R2	9.5
Gigabit Ethernet IQ2E PICs					
Gigabit Ethernet IQ2E, 8-port SFP (Type 2)	PB-8GE-TYPE2-SFP-IQ2E	—	9.4	9.4	—
Services PICs					
MultiServices 400	PB-MS-400-2	—	8.1R2	8.1R2	9.5
Tunnel Services	PB-TUNNEL	6.1	6.3	7.4	9.5
SONET/SDH PICs					
OC3c/STM1 (Multi-Rate), 4-port (Type 2)	PB-4OC3-IOC12-SON2-SFP	—	8.3	8.3	—

Table 6: T640 PIC/FPC Compatibility Type 2 (continued)

PIC	PIC Model Number	T640-FPC2	T640-FPC2-E	T640-FPC2-E2	T640-FPC2-ES
OC12c/STM4 (Multi-Rate), 4-port (Type 2)	PB-4OC3-4OC12-SON-SFP	–	8.3	8.3	9.5
OC48c/ STM16, 1-port SFP	PB-1OC48-SON-SFP	6.1	6.3	7.4	–
OC48/STM16 (Multi-Rate), 4-port (Type 2)	PB-1OC48-SON-B-SFP	–	8.3	8.3	9.5

PIC/FPC Compatibility (Type 3 FPCs and Type 3 PICs)

Table 7 on page 15 provides a PIC/FPC compatibility matrix for the current Type 3 PICs for the T640 router and Type 3 FPCs.

Table 7: T640 PIC/FPC Compatibility Type 3

PIC	PIC Model Number	T640-FPC3	T640-FPC3-E	T640-FPC3-E2	T640-FPC3-ES
Channelized IQE PICs					
ChOC12/STM4 IQE, 4-port	PC-4CHOC12-STM4-IQE-SFP in a standalone T640 router This PIC is not supported in a T640 router connected to a TX Matrix router.	–	–	–	10.0R2
Gigabit Ethernet PICs					
Gigabit Ethernet, 10-port SFP	PC-10-GE-SFP	5.5	6.3	7.4	9.0
Gigabit Ethernet and 10-Gigabit Ethernet IQ2 PICs					
Gigabit Ethernet IQ2, 8-port SFP (Type 3)	PC-8GE-TYPE3-SFP-IQ2	8.2	8.2	8.2	9.0
10-Gigabit Ethernet IQ2, 1-port XFP	PC-1XGE-TYPE3-XFP-IQ2	8.0R3	8.0R3	8.0R3	9.0
Gigabit Ethernet and 10-Gigabit Ethernet IQ2E PICs					
Gigabit Ethernet IQ2E, 8-port SFP (Type 3)	PC-8GE-TYPE3-SFP-IQ2E	9.4	9.4	9.4	9.4
10-Gigabit Ethernet IQ2E, 1-port XFP	PC-1XGE-TYPE3-XFP-IQ2E	9.4	9.4	9.4	9.4

Table 7: T640 PIC/FPC Compatibility Type 3 (continued)

PIC	PIC Model Number	T640-FPC3	T640-FPC3-E	T640-FPC3-E2	T640-FPC3-ES
10-Gigabit Ethernet PICs					
10-Gigabit Ethernet, 1-port XENPAK	PC-1XGE-XENPAK with 10GBASE-ER and 10GBASE-LR transceivers installed	6.2	6.3	7.4	9.0
	PC-1XGE-XENPAK with 10GBASE-SR and 10GBASE-ZR transceivers installed	7.1	7.1	7.4:	9.0
10-Gigabit Ethernet, 1-port DWDM	PC-1XGE-DWDM-CBAND	7.5	7.5	7.5	9.0
10-Gigabit Ethernet, 1-port DWDM OTN	PC-1XGE-DWDM-OTN	9.4	9.4	9.4	9.4
Services PICs					
MultiServices 500	PC-MS-500-3	–	8.3	8.3	9.3
Tunnel Services	PC-TUNNEL	5.3	6.3	7.4	9.0
SONET/SDH PICs					
OC48/STM16 IQE, 4-port SFP	PC-4OC48-STM16-IQE-SFP in a standalone T640 router	–	–	–	10.4R2
	This PIC is not supported in a T640 router connected to a TX Matrix router.				
OC48c/STM16, 4-port SFP	PC-4OC48-SON-SFP	6.2	6.3	7.4	9.0
OC192c / STM64, 1-port	PC-1OC192-SON-VSR	5.3	6.3	7.4	9.0
OC192c / STM64, 1-port XFP	PC-1OC192-SON-XFP	–	8.1	8.1	9.0

PIC/FPC Compatibility (Type 4 FPCs and Type 4 PICs)

Table 8 on page 17 provides a PIC/FPC compatibility matrix for the current Type 4 PICs for the T640 router and Type 4 FPCs.

Table 8: T640 PIC/FPC Compatibility Type 4

PIC	PIC Model Number	T640-FPC4-ES	T640-FPC4-1P-ES
10-Gigabit Ethernet PICs			
10-Gigabit LAN/WAN with SFP+	PD-5-10XGE-SFPP	10.1	10.1
10-Gigabit Ethernet, 4-port LAN/WAN with XFP	PD-4XGE-XFP	9.0	9.5
40 Gigabit Ethernet PICs			
40-Gigabit with CFP	PD-1XLE-CFP	–	11.4
Services PICs			
40-Gigabit Tunnel Services	PD-TUNNEL	7.5	9.5
SONET/SDH PICs			
OC192c / STM64, 4-port XFP	PD-4OC192-SON-XFP	8.1	9.5
OC768c/ STM256, 1-port	PD-1OC768-SON-SR	7.5	9.5

- Related Documentation**
- *T640 PIC Description*
 - *T640 PIC Combination Limitations*
 - [T640 PICs Supported on page 3](#)
 - *T640 FPCs Supported*

CHAPTER 2

Network Interface Specifications

- Supported Network Interface Standards by Transceiver for ACX Series, M Series, MX Series, and T Series Routers on page 19
- Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications on page 28
- Gigabit Ethernet 1000BASE Optical Interface Specifications on page 32
- Gigabit Ethernet 1000BASE-T Copper Interface Specifications on page 35
- 10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 36
- 10-Gigabit Ethernet DWDM Optical Interface Specifications on page 41
- 10-Gigabit Ethernet DWDM Transceiver Wavelengths on page 41
- 40-Gigabit Ethernet 40GBASE-R Optical Interface Specifications on page 43
- SONET/SDH OC3/STM1 Optical Interface Specifications on page 46
- SONET/SDH OC12/STM4 Optical Interface Specifications on page 48
- SONET/SDH OC48/STM16 Optical Interface Specifications on page 51
- SONET/SDH OC192/STM64 Optical Interface Specifications on page 53
- SONET/SDH OC768/STM256 Optical Interface Specifications on page 57

Supported Network Interface Standards by Transceiver for ACX Series, M Series, MX Series, and T Series Routers

Table 9 on page 20 and Table 10 on page 27 list the transceivers supported by ACX, M, MX, and T Series devices.



NOTE: Not all transceivers are supported on all devices. To determine which transceivers are supported in a particular device, see the “Cables and Connectors” section for each PIC, MIC, or line card in the *Interface Module Reference* for your device, or see the [Hardware Compatibility Tool](#).



TIP: You can use the [Hardware Compatibility Tool](#) to find information about the pluggable transceivers supported on your Juniper Networks device.

- [Table 9 on page 20](#) lists the supported Ethernet standards for each transceiver.
- [Table 10 on page 27](#) lists the supported SONET standards for each transceiver.

Some transceivers support monitoring by using the operational mode CLI command **show interfaces diagnostics optics**. To determine which transceivers support monitoring, refer to the “Monitoring Available” column in [Table 9 on page 20](#) and [Table 10 on page 27](#). For a description of the monitoring fields displayed by the transceiver, see *show interfaces diagnostics optics (Gigabit Ethernet, 10-Gigabit Ethernet, 40-Gigabit Ethernet, 100-Gigabit Ethernet, and Virtual Chassis Port)* or *show interfaces diagnostics optics (SONET)*.



CAUTION: If you face a problem running a Juniper Networks device that uses a third-party optic or cable, the Juniper Networks Technical Assistance Center (JTAC) can help you diagnose the source of the problem. Your JTAC engineer might recommend that you check the third-party optic or cable and potentially replace it with an equivalent Juniper Networks optic or cable that is qualified for the device.



NOTE: For XFP transceivers that can support either the 10-Gigabit Ethernet or SONET OC192/STM64 specifications, check the standard supported for the device into which the transceiver is installed. For example, the XFP-10G-E-OC192-IR2 transceiver installed in a 10-Gigabit Ethernet PIC supports the 10GBASE-E standard. However, the XFP-10G-E-OC192-IR2 transceiver installed in a SONET OC192/STM64 PIC supports the SONET OC192/STM64 IR2 standard.

[Table 9 on page 20](#) is organized by transmission speed and then alphabetically by model number.

Table 9: Supported Ethernet Standards

Model Number	Transceiver Type	Connector	Monitoring Available	Standard	Specifications
Ethernet 10BASE, Fast Ethernet 100BASE, and Gigabit Ethernet 1000BASE Specifications					
SFP-1FE-FX	SFP	LC	No	100BASE-FX	• <i>Fast Ethernet 100BASE-FX Optical Interface Specifications</i>
SFP-1GE-FE-E-T	SFP	RJ-45	No	10/100/1000 BASE-T	• <i>Ethernet 10BASE-T Copper Interface Specifications</i> • <i>Fast Ethernet 100BASE-T Copper Interface Specifications</i> • Gigabit Ethernet 1000BASE-T Copper Interface Specifications on page 35

Table 9: Supported Ethernet Standards (*continued*)

Model Number	Transceiver Type	Connector	Monitoring Available	Standard	Specifications
SFP-1GE-LH	SFP	LC	Yes	1000BASE-LH	Gigabit Ethernet 1000BASE Optical Interface Specifications on page 32
SFP-1GE-LX	SFP	LC	Yes	1000BASE-LX 1000BASE-LX10	Gigabit Ethernet 1000BASE Optical Interface Specifications on page 32
SFP-1GE-SX	SFP	LC	Yes	1000BASE-SX	Gigabit Ethernet 1000BASE Optical Interface Specifications on page 32
SFP-1GE-T	SFP	RJ-45	No	1000BASE-T	Gigabit Ethernet 1000BASE-T Copper Interface Specifications on page 35
SFP-FE20KT13R15	SFP	LC	No	100BASE-BX	Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications on page 28
SFP-FE20KT15R13	SFP	LC	No	100BASE-BX	Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications on page 28
SFP-GE10KT13R14	SFP	LC	Yes	1000BASE-BX	Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications on page 28
SFP-GE10KT13R15	SFP	LC	Yes	1000BASE-BX	Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications on page 28
SFP-GE10KT14R13	SFP	LC	Yes	1000BASE-BX	Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications on page 28

Table 9: Supported Ethernet Standards (*continued*)

Model Number	Transceiver Type	Connector	Monitoring Available	Standard	Specifications
SFP-GE10KT15R13	SFP	LC	Yes	1000BASE-BX	Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications on page 28
SFP-GE40KM	SFP	LC	Yes	1000BASE-EX	Gigabit Ethernet 1000BASE Optical Interface Specifications on page 32
SFP-GE40KT13R15	SFP	LC	Yes	1000BASE-BX	Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications on page 28
SFP-GE40KT15R13	SFP	LC	Yes	1000BASE-BX	Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications on page 28
SFP-GE80KCW1470-ET	SFP	LC	Yes	NA	Gigabit Ethernet SFP CWDM Optical Interface Specifications
SFP-GE80KCW1490-ET	SFP	LC	Yes	NA	Gigabit Ethernet SFP CWDM Optical Interface Specifications
SFP-GE80KCW1510-ET	SFP	LC	Yes	NA	Gigabit Ethernet SFP CWDM Optical Interface Specifications
SFP-GE80KCW1530-ET	SFP	LC	Yes	NA	Gigabit Ethernet SFP CWDM Optical Interface Specifications
SFP-GE80KCW1550-ET	SFP	LC	Yes	NA	Gigabit Ethernet SFP CWDM Optical Interface Specifications
SFP-GE80KCW1570-ET	SFP	LC	Yes	NA	Gigabit Ethernet SFP CWDM Optical Interface Specifications
SFP-GE80KCW1590-ET	SFP	LC	Yes	NA	Gigabit Ethernet SFP CWDM Optical Interface Specifications

Table 9: Supported Ethernet Standards (*continued*)

Model Number	Transceiver Type	Connector	Monitoring Available	Standard	Specifications
SFP-GE80KCWI610-ET	SFP	LC	Yes	NA	<i>Gigabit Ethernet SFP CWDM Optical Interface Specifications</i>
10-Gigabit Ethernet 10GBASE Specifications					
PC-1XGE-DWDM-CBAND	Fixed	SC	Yes	10-Gigabit Ethernet dense wavelength-division multiplexing (DWDM)	<i>10-Gigabit Ethernet DWDM Optical Interface Specifications on page 41</i> <i>10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 36</i>
PC-1XGE-DWDM-OTN	Fixed	SC	Yes	10-Gigabit Ethernet dense wavelength-division multiplexing (DWDM) OTN	<i>10-Gigabit Ethernet DWDM OTN Optical Interface Specifications</i> <i>10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 36</i>
SFPP-10G-CT50-ZR	SFP+	LC	Yes	10GBASE-Z	<i>10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 36</i>
SFPP-10G-DT-ZRC2	SFP+	LC	Yes	10BASE-Z	<i>10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 36</i>
SFPP-10G-ER-OTN	SFP+	LC	Yes	10GBASE-ER	<i>10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 36</i>
SFPP-10G-LR-OTN	SFP+	LC	Yes	10GBASE-LR	<i>10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 36</i>
SFPP-10G-ZR-OTN-XT	SFP+	LC	Yes	10GBASE-Z	<i>10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 36</i>
SFPP-10GE-ER	SFP+	LC	Yes	10GBASE-ER	<i>10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 36</i>

Table 9: Supported Ethernet Standards (*continued*)

Model Number	Transceiver Type	Connector	Monitoring Available	Standard	Specifications
SFPP-10GE-LR	SFP+	LC	Yes	10GBASE-LR	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 36
SFPP-10GE-LRM	SFP+	LC	Yes	10GBASE-LRM	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 36
SFPP-10GE-SR	SFP+	LC	Yes	10GBASE-SR	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 36
SFPP-10GE-ZR	SFP+	LC	Yes	10GBASE-Z	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 36
XENPAK-1XGE-ER	XENPAK	SC	Yes	10GBASE-ER	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 36
XENPAK-1XGE-LR	XENPAK	SC	Yes	10GBASE-LR	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 36
XENPAK-1XGE-SR	XENPAK	SC	Yes	10GBASE-SR	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 36
XENPAK-1XGE-ZR EOL (see PSN-2010-02-649)	XENPAK	SC	Yes	10GBASE-Z	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 36
XFP-10G-CBAND-T50-ZR	XFP	LC	Yes	10GBASE-Z 10-Gigabit Ethernet dense wavelength-division multiplexing (DWDM)	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 36
XFP-10G-E-OC192-IR2	XFP	LC	Yes	10GBASE-E	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 36

Table 9: Supported Ethernet Standards (*continued*)

Model Number	Transceiver Type	Connector	Monitoring Available	Standard	Specifications
XFP-10G-L-OC192-SR1	XFP	LC	Yes	10GBASE-L	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 36
XFP-10G-S	XFP	LC	Yes	10GBASE-S	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 36
XFP-10G-Z-OC192-LR2	XFP	LC	Yes	10GBASE-Z	10-Gigabit Ethernet 10GBASE Optical Interface Specifications on page 36
40-Gigabit Ethernet 40GBASE Specifications					
CFP-40GBASE-LR4	CFP	SC	Yes	40GBASE-LR4	40-Gigabit Ethernet 40GBASE-R Optical Interface Specifications on page 43
QSFP-40G-LX4	QSFP+	LC	Yes	40GBASE-LX4	40-Gigabit Ethernet 40GBASE-R Optical Interface Specifications on page 43
QSFP-40GE-LX4	QSFP+	LC	Yes	40GBASE-LX4	40-Gigabit Ethernet 40GBASE-R Optical Interface Specifications on page 43
QSFP-40GBASE-ER4	QSFP+	LC	Yes	40GBASE-ER4	40-Gigabit Ethernet 40GBASE-R Optical Interface Specifications on page 43
QSFP-40GBASE-LR4	QSFP+	LC	Yes	40GBASE-LR4	40-Gigabit Ethernet 40GBASE-R Optical Interface Specifications on page 43
QSFP-40GBASE-SR4	QSFP+	12-fiber MPO	Yes	40GBASE-SR4	40-Gigabit Ethernet 40GBASE-R Optical Interface Specifications on page 43
100-Gigabit Ethernet 100GBASE-R Specifications					
CFP-100GBASE-ER4	CFP	LC	Yes	100GBASE-ER4	100-Gigabit Ethernet 100GBASE-R Optical Interface Specifications

Table 9: Supported Ethernet Standards (*continued*)

Model Number	Transceiver Type	Connector	Monitoring Available	Standard	Specifications
CFP-GEN2-CGE-ER4	CFP	LC	Yes	100GBASE-ER4	100-Gigabit Ethernet 100GBASE-R Optical Interface Specifications
CFP-100GBASE-LR4	CFP	SC	Yes	100GBASE-LR4	100-Gigabit Ethernet 100GBASE-R Optical Interface Specifications
CFP-GEN2-100GBASE-LR4	CFP	LC	Yes	100GBASE-LR4	100-Gigabit Ethernet 100GBASE-R Optical Interface Specifications
CFP-100GBASE-SR10	CFP	24-fiber MPO	Yes NOTE: Optical power monitoring is not supported.	100GBASE-SR10	100-Gigabit Ethernet 100GBASE-R Optical Interface Specifications
CFP-100GBASE-ZR	CFP	LC	Yes	None	See the Juniper Networks specification in the <i>100-Gigabit Ethernet 100GBASE-R Optical Interface Specifications</i>.
CFP2-100GBASE-LR4	CFP2	LC	Yes	100GBASE-LR4	See the Juniper Networks specification in the <i>100-Gigabit Ethernet 100GBASE-R Optical Interface Specifications</i>.
CFP2-100G-ER4-D	CFP2	LC	Yes	100GBASE-ER4	See the Juniper Networks specification in the <i>100-Gigabit Ethernet 100GBASE-R Optical Interface Specifications</i>.
CFP2-100G-SR10-D3	CFP2	24-fiber MPO	Yes	100GBASE-SR10	See the Juniper Networks specification in the <i>100-Gigabit Ethernet 100GBASE-R Optical Interface Specifications</i>.
CXP-100GBASE-SR10	CXP	24-fiber MPO	Yes	100GBASE-SR10	100-Gigabit Ethernet 100GBASE-R Optical Interface Specifications

Table 9: Supported Ethernet Standards (*continued*)

Model Number	Transceiver Type	Connector	Monitoring Available	Standard	Specifications
QSFP28-100G-SR4	QSFP28	12-fiber MPO	Yes	100G-SR4	100-Gigabit Ethernet 100GBASE-R Optical Interface Specifications
QSFP28-100G-LR4	QSFP28	LC	Yes	100G-LR4	100-Gigabit Ethernet 100GBASE-R Optical Interface Specifications
TCFP2-100G-C	CFP2-ACO	LC/UPC	Yes	100-Gigabit DWDM OTN	100-Gigabit DWDM OTN CFP2-ACO Transceiver Wavelengths

Table 10 on page 27 is organized by transmission speed and then alphabetically by model number.

Table 10: Supported SONET Standards

Model Number	Transceiver Type	Connector	Monitoring Available	Standard	Specifications
SONET OC3/STM1 Specifications					
SFP-OC3-IR	SFP	LC	Yes	SONET/SDH OC3/STM1 Intermediate Reach	SONET/SDH OC3/STM1 Optical Interface Specifications on page 46
SFP-OC3-LR	SFP	LC	Yes	SONET/SDH OC3/STM1 Long Reach	SONET/SDH OC3/STM1 Optical Interface Specifications on page 46
SFP-OC3-SR	SFP	LC	Yes	SONET/SDH OC3/STM1 Multimode	SONET/SDH OC3/STM1 Optical Interface Specifications on page 46
SONET OC12/STM4 Specifications					
SFP-OC12-IR	SFP	LC	Yes	SONET/SDH OC12/STM4 Intermediate Reach (IR-1)	SONET/SDH OC12/STM4 Optical Interface Specifications on page 48
SFP-OC12-LR	SFP	LC	Yes	SONET/SDH OC12/STM4 Long Reach (LR-1)	SONET/SDH OC12/STM4 Optical Interface Specifications on page 48
SFP-OC12-LR2	SFP	LC	Yes	SONET/SDH OC12/STM4 Long Reach (LR-2)	SONET/SDH OC12/STM4 Optical Interface Specifications on page 48
SFP-OC12-SR	SFP	LC	Yes	SONET/SDH OC12/STM4 Short Reach (SR-1)	SONET/SDH OC12/STM4 Optical Interface Specifications on page 48

Table 10: Supported SONET Standards *(continued)*

Model Number	Transceiver Type	Connector	Monitoring Available	Standard	Specifications
SONET OC48/STM16 Specifications					
SFP-1OC48-IR	SFP	LC	No	SONET/SDH OC48/STM16 Intermediate Reach (IR-1)	SONET/SDH OC48/STM16 Optical Interface Specifications on page 51
SFP-1OC48-LR	SFP	LC	Yes	SONET/SDH OC48/STM16 Long Reach (LR-2)	SONET/SDH OC48/STM16 Optical Interface Specifications on page 51
SFP-1OC48-SR	SFP	LC	No	SONET/SDH OC48/STM16 Short Reach (SR-1)	SONET/SDH OC48/STM16 Optical Interface Specifications on page 51
SONET OC192/STM64 Specifications					
XFP-10G-E-OC192-IR2	XFP	LC	Yes	SONET/SDH OC192/STM64 Intermediate Reach (IR-2)	SONET/SDH OC192/STM64 Optical Interface Specifications on page 53
XFP-10G-L-OC192-SR1	XFP	LC	Yes	SONET/SDH OC192/STM64 Short Reach (SR-1)	SONET/SDH OC192/STM64 Optical Interface Specifications on page 53
XFP-10G-Z-OC192-LR2	XFP	LC	Yes	SONET/SDH OC192/STM64 Long Reach (LR-2)	SONET/SDH OC192/STM64 Optical Interface Specifications on page 53
SONET OC768/STM256 Specifications					
PD-1OC768-SON-SR	Fixed	SC	Yes	SONET/SDH OC768/STM256 Short Reach (SR)	SONET/SDH OC768/STM256 Optical Interface Specifications on page 57

Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications

The bidirectional SFP standards are supported on M Series, MX Series, and T Series routers.

To determine which transceivers support each bidirectional SFP standard, see [“Supported Network Interface Standards by Transceiver for ACX Series, M Series, MX Series, and T Series Routers” on page 19](#). The “Cables and connectors” section in the description for each MIC or PIC lists which standards and transceivers are supported for that device.

The standards are organized by distance supported.

- [Fast Ethernet 100BASE-BX Bidirectional SFP Optical Interface Specifications on page 29](#)
- [Gigabit Ethernet 1000BASE-BX Bidirectional SFP \(U 13/14 and D 14/13\) Optical Interface Specifications on page 30](#)
- [Gigabit Ethernet 1000BASE-BX Bidirectional SFP \(U 13/15 and D 15/13\) Optical Interface Specifications on page 30](#)
- [Gigabit Ethernet 1000BASE-BX Bidirectional SFP \(40 U 13/15 and D 15/13\) Optical Interface Specifications on page 31](#)

Fast Ethernet 100BASE-BX Bidirectional SFP Optical Interface Specifications

[Table 11 on page 29](#) shows the optical specifications for 100BASE-BX bidirectional SFPs. 100BASE-BX bidirectional interfaces are supported in Junos OS Release 9.6 and later and must be used in pairs.

Table 11: Fast Ethernet 100BASE-BX Bidirectional SFP Optical Interface Specifications

Parameter	100BASE-BX-U	100BASE-BX-D
Pairs with	100BASE-BX-D	100BASE-BX-U
Transceiver model number	SFP-FE20KT13R15	SFP-FE20KT15R13
Rate	100 Mbps	100 Mbps
Optical interface	Single-mode	Single-mode
Transceiver type	SFP	SFP
Standard	100BASE-BX IEEE 802.3-2005	100BASE-BX IEEE 802.3-2005
Maximum distance	9/125 SMF cable: 12.4 miles (20 km)	9/125 SMF cable: 12.4 miles (20 km)
Transmitter wavelength	1260 through 1360 nm	1480 through 1580 nm
Average launch power	–14 through –8 dBm	–14 through –8 dBm
Average receive power	–45 through –8 dBm	–45 through –8 dBm
Receiver saturation	–8 dBm	–8 dBm
Receiver sensitivity	–45 dBm	–45 dBm

Gigabit Ethernet 1000BASE-BX Bidirectional SFP (U 13/14 and D 14/13) Optical Interface Specifications

Table 12 on page 30 shows the optical specifications for 1000BASE-BX bidirectional SFPs. 1000BASE-BX bidirectional interfaces are supported in Junos OS Release 9.0 and later and must be used in pairs.

Table 12: Gigabit Ethernet 1000BASE-BX Bidirectional SFP (U 13/14 and D 14/13) Optical Interface Specifications

Parameter	1000BASE-BX10-U 13/14	1000BASE-BX10-D 14/13
Pairs with	1000BASE-BX10-D 14/13	1000BASE-BX10-U 13/14
Transceiver model number	SFP-GE10KT13R14	SFP-GE10KT14R13
Rate	1000 Mbps	1000 Mbps
Optical interface	Single-mode	Single-mode
Transceiver type	SFP	SFP
Standard	IEEE 802.3-2005	IEEE 802.3-2005
Maximum distance	9/125 SMF cable: 6.2 miles (10 km)	9/125 SMF cable: 6.2 miles (10 km)
Transmitter wavelength	1260 through 1360 nm	1480 through 1500 nm
Average launch power	–9 through –3 dBm	–9 through –3 dBm
Average receive power	–19.5 through –3 dBm	–19.5 through –3 dBm
Receiver saturation	–3 dBm	–3 dBm
Receiver sensitivity	–19.5 dBm	–19.5 dBm

Gigabit Ethernet 1000BASE-BX Bidirectional SFP (U 13/15 and D 15/13) Optical Interface Specifications

Table 14 on page 31 shows the optical specifications for 1000BASE-BX bidirectional SFPs. 1000BASE-BX bidirectional interfaces are supported in Junos OS Release 9.0 and later and must be used in pairs.

Table 13: Gigabit Ethernet 1000BASE-BX Bidirectional SFP (U 13/15 and D 15/13) Optical Interface Specifications

Parameter	1000BASE-BX10-U 13/15	1000BASE-BX10-D 15/13
Pairs with	1000BASE-BX10-D 15/13	1000BASE-BX10-U 13/15

Table 13: Gigabit Ethernet 1000BASE-BX Bidirectional SFP (U 13/15 and D 15/13) Optical Interface Specifications (*continued*)

Parameter	1000BASE-BX10-U 13/15	1000BASE-BX10-D 15/13
Transceiver model number	SFP-GE10KT13R15	SFP-GE10KT15R13
Rate	1000 Mbps	1000 Mbps
Optical interface	Single-mode	Single-mode
Transceiver type	SFP	SFP
Standard	Multivendor agreement	Multivendor agreement
Maximum distance	9/125 SMF cable: 6.2 miles (10 km)	9/125 SMF cable: 6.2 miles (10 km)
Transmitter wavelength	1270 through 1360 nm	1530 through 1570 nm
Average launch power	–9 through –3 dBm	–9 through –3 dBm
Average receive power	–20 through –3 dBm	–20 through –3 dBm
Receiver saturation	–3 dBm	–3 dBm
Receiver sensitivity	–20 dBm	–20 dBm

Gigabit Ethernet 1000BASE-BX Bidirectional SFP (40 U 13/15 and D 15/13) Optical Interface Specifications

Table 13 on page 30 shows the optical specifications for 1000BASE-BX bidirectional SFPs. 1000BASE-BX bidirectional interfaces are supported in JUNOS 9.0 and later and must be used in pairs.

Table 14: Gigabit Ethernet 1000BASE-BX Bidirectional SFP (40 U 13/15 and D 15/13) Optical Interface Specifications

Parameter	1000BASE-BX40-U 13/15	1000BASE-BX40-D 15/13
Pairs with	1000BASE-BX40-D 15/13	1000BASE-BX40-U 13/15
Transceiver model number	SFP-GE40KT13R15	SFP-GE40KT15R13
Rate	1000 Mbps	1000 Mbps
Optical interface	Single-mode	Single-mode
Transceiver type	SFP	SFP
Standard	Multivendor agreement	Multivendor agreement

Table 14: Gigabit Ethernet 1000BASE-BX Bidirectional SFP (40 U 13/15 and D 15/13) Optical Interface Specifications (*continued*)

Parameter	1000BASE-BX40-U 13/15	1000BASE-BX40-D 15/13
Maximum distance	9/125 SMF cable: 24.9 miles (40 km)	9/125 SMF cable: 24.9 miles (40 km)
Transmitter wavelength	1260 through 1360 nm	1530 through 1570 nm
Average launch power	-3 through 2 dBm	-7 through 2 dBm
Average receive power	-23 through -3 dBm	-23 through -3 dBm
Receiver saturation	-3 dBm	-3 dBm
Receiver sensitivity	-23 dBm	-23 dBm

Related Documentation • [Supported Network Interface Standards by Transceiver for ACX Series, M Series, MX Series, and T Series Routers on page 19](#)

Gigabit Ethernet 1000BASE Optical Interface Specifications

To determine which transceivers support each Gigabit Ethernet 1000BASE standard, see [“Supported Network Interface Standards by Transceiver for ACX Series, M Series, MX Series, and T Series Routers” on page 19](#). The “Cables and connectors” section in the description for each DPC, MIC, or PIC lists which standards and transceivers are supported.

The standards are organized by distance supported.

- [Gigabit Ethernet 1000BASE-SX Optical Interface Specifications on page 32](#)
- [Gigabit Ethernet 1000BASE-LX Optical Interface Specifications on page 33](#)
- [Gigabit Ethernet 1000BASE-LX10 Optical Interface Specifications on page 33](#)
- [Gigabit Ethernet 1000BASE-EX Optical Interface Specifications on page 34](#)
- [Gigabit Ethernet 1000BASE-LH Optical Interface Specifications on page 35](#)

Gigabit Ethernet 1000BASE-SX Optical Interface Specifications

[Table 15 on page 32](#) shows the optical interface specifications for the 1000BASE-SX standard.

Table 15: Gigabit Ethernet 1000BASE-SX Optical Interface Specifications

Parameter	1000BASE-SX
Rate	1000 Mbps
Optical interface	Multimode

Table 15: Gigabit Ethernet 1000BASE-SX Optical Interface Specifications (*continued*)

Parameter	1000BASE-SX
Maximum distance	62.5/125 MMF cable: 656 ft (200 m) 50/125 MMF cable: 1640 ft (500 m)
Transmitter wavelength	770 through 860 nm
Average launch power	−9.5 through 0 dBm
Average receive power	−17 through 0 dBm
Receiver saturation	0 dBm
Receiver sensitivity	−17 dBm

Gigabit Ethernet 1000BASE-LX Optical Interface Specifications

Table 16 on page 33 shows the optical interface specifications for the 1000BASE-LX standard.

Table 16: Gigabit Ethernet 1000BASE-LX Optical Interface Specifications

Parameter	1000BASE-LX
Rate	1000 Mbps
Optical interface	Multimode and single-mode
Maximum distance	62.5/125 and 50/125 MMF cable: 1804.5 ft (550 m) 9/125 SMF cable: 6.2 miles (10 km)
Transmitter wavelength	1270 through 1355 nm
Average launch power	−11.5 through −3 dBm
Average receive power	−19 through −3 dBm
Receiver saturation	−3 dBm
Receiver sensitivity	−19 dBm

Gigabit Ethernet 1000BASE-LX10 Optical Interface Specifications

Table 17 on page 34 shows the optical interface specifications for the 1000BASE-LX10 standard.

Table 17: Gigabit Ethernet 1000BASE-LX10 Optical Interface Specifications

Parameter	1000BASE-LX10
Rate	1000 Mbps
Optical interface	Single-mode
Maximum distance	9/125 SMF cable: 6.2 miles (10 km)
Transmitter wavelength	1270 through 1355 nm
Average launch power	-11.5 through -3 dBm
Average receive power	-19 through -3 dBm
Receiver saturation	-3 dBm
Receiver sensitivity	-19 dBm

Gigabit Ethernet 1000BASE-EX Optical Interface Specifications

Table 17 on page 34 shows the optical interface specifications for the 1000BASE-EX standard.

Table 18: Gigabit Ethernet 1000BASE-EX Optical Interface Specifications

Parameter	1000BASE-EX
Rate	1000 Mbps
Optical interface	Single-mode
Maximum distance	9/125 SMF cable: 24.85 miles (40 km)
Transmitter wavelength	1260 through 1360 nm
Average launch power	-4.5 through 0 dBm
Average receive power	-22.5 through -3 dBm
Receiver saturation	-3 dBm
Receiver sensitivity	-22.5 dBm

Gigabit Ethernet 1000BASE-LH Optical Interface Specifications

Table 19: Gigabit Ethernet 1000BASE-LH Optical Interface Specifications

Parameter	1000BASE-LH
Rate	1000 Mbps
Optical interface	Single-mode
Maximum distance	9/125 SMF cable: 43.5 miles (70 km)
Transmitter wavelength	1460 through 1580 nm
Average launch power	–3 through +3 dBm
Average receive power	–20 through –3 dBm
Receiver saturation	–3 dBm
Receiver sensitivity	–20 dBm

**Related
Documentation**

- [Supported Network Interface Standards by Transceiver for ACX Series, M Series, MX Series, and T Series Routers on page 19](#)

Gigabit Ethernet 1000BASE-T Copper Interface Specifications

The 1000BASE-T copper standard is supported on M Series, MX Series, and T Series routers.

To determine which transceivers support the 1000BASE-T copper standard, see “Supported Network Interface Standards by Transceiver for ACX Series, M Series, MX Series, and T Series Routers” on page 19. The “Cables and connectors” section in the description for each MIC or PIC lists which standards and transceivers are supported for that device.

[Table 20 on page 35](#) shows the copper interface specifications for the 1000BASE-T standard.

Table 20: 1000BASE-T Copper Interface Specifications

Parameter	1000BASE-T
Rate	1000 Mbps autosensing
Distance	328 ft (100 m)
Cable	Four-pair, Category 5 shielded twisted-pair

- Related Documentation**
- [Supported Network Interface Standards by Transceiver for ACX Series, M Series, MX Series, and T Series Routers on page 19](#)

10-Gigabit Ethernet 10GBASE Optical Interface Specifications

To determine which transceivers support each 10GBASE standard, see “[Supported Network Interface Standards by Transceiver for ACX Series, M Series, MX Series, and T Series Routers](#)” on page 19. The “Cables and Connectors” section in the description for each MIC or PIC lists which standards and transceivers are supported for that device.



NOTE: Some XFP transceivers can support either the 10-Gigabit Ethernet or SONET/SDH OC192/STM64 specifications. Check the standard supported for the device in which the transceiver is installed. For example, the XFP-10G-E-OC192-IR2 transceiver installed in a 10-Gigabit Ethernet PIC supports the 10GBASE-E standard. However, the XFP-10G-E-OC192-IR2 transceiver installed in a SONET/SDH OC192/STM64 PIC supports the SONET/SDH OC192/STM64 IR2 standard.

The specifications are organized by distance supported.

- [10GBASE-LRM Specifications on page 36](#)
- [10GBASE-S Specifications on page 37](#)
- [10GBASE-L Specifications on page 38](#)
- [10GBASE-E Specifications on page 38](#)
- [10GBASE-Z Specifications on page 39](#)

10GBASE-LRM Specifications

[Table 21 on page 36](#) shows the optical interface specifications for the 10GBASE-LRM standard.

Table 21: 10GBASE-LRM Optical Interface Specifications

Parameter	10GBASE-LRM
Optical interface	Single-mode Multimode
Standard	IEEE 802.3aq—2006
Maximum distance	Single-mode: 9/125 SMF cable: 300 m (984 ft) Multimode: • 62.5 /125 MMF cable, 500 MHz-km: 220 m (722 ft) • 50/125 MMF cable, 500 MHz-km: 220 m (722 ft) • 50/125 MMF cable, 400 MHz-km: 100 m (328 ft)

Table 21: 10GBASE-LRM Optical Interface Specifications (*continued*)

Parameter	10GBASE-LRM
Transmitter wavelength	1260 through 1355 nm
Average launch power	−6.5 through +0.5 dBm
Average receive power	−8.4 through +0.5 dBm
Overload in OMA	+1.5 dBm
Stressed sensitivity in OMA	−6.5 dBm

10GBASE-S Specifications

Table 22 on page 37 shows the optical interface specifications for the 10GBASE-SR and 10GBASE-SW standards.



NOTE: The XFP-10G-L-OC192-SR1 transceiver supports single-mode fiber and the 10GBASE-L optical interface specifications.

Table 22: 10GBASE-S (10GBASE-SR and 10GBASE-SW) Optical Interface Specifications

Parameter	10GBASE-S
Optical interface	Multimode
Standard	IEEE 802.3ae—2002
Maximum distance	50/125 MMF cable, 400 MHz-km: 66 m (217 ft) 50/125 MMF cable, 500 MHz-km: 82 m (269 ft) 50/125 MMF cable, 2000 MHz-km: 300 m (948 ft) 50/125 MMF cable, 4700 MHz-km: 400 m (1312 ft) 62.5/125 MMF cable, 200 MHz-km: 33 m (108 ft) 62.5/125 MMF cable, 160 MHz-km: 26 m (85 ft)
Transmitter wavelength	840 through 860 nm
Average launch power	−7.3 through −1.0 dBm
Average receive power	−9.9 through −1.0 dBm
Receiver saturation	−1.0 dBm
Receiver sensitivity (max) in OMA	−11.1 dBm

10GBASE-L Specifications

Table 23 on page 38 shows the optical interface specifications for the 10GBASE-LR and 10GBASE-LW standards.

Table 23: 10GBASE-L (10GBASE-LR and 10GBASE-LW) Optical Interface Specifications

Parameter	10GBASE-L
Optical interface	Single-mode
Standard	IEEE 802.3ae—2002
Maximum distance	9/125 SMF cable: 10 km (6.2 miles)
Transmitter wavelength	1260 through 1355 nm
Average launch power	–8.2 through 0.5 dBm
Average receive power	–14.4 through 0.5 dBm
Receiver saturation	0.5 dBm
Receiver sensitivity (max) in OMA	–12.6 dBm

10GBASE-E Specifications

Table 24 on page 38 shows the optical interface specifications for the 10GBASE-ER and 10GBASE-EW standards.

Table 24: 10GBASE-E (10GBASE-ER and 10GBASE-EW) Optical Interface Specifications

Parameter	10GBASE-E
Optical interface	Single-mode
Standard	IEEE 802.3ae—2002
Maximum distance	9/125 SMF cable: 40 km (24.8 miles); distances greater than 30 km (18.6 miles) are considered to be engineered links. NOTE: Any distance greater than 30 km requires engineered links that must be field-tested to verify the conformance of the 10.9 dB channel insertion loss specification. EANSI/TIA/EIA-526-7/Method A1 describes the insertion loss measurement of installed fiber-optic cables.
Transmitter wavelength	1530 through 1565 nm

Table 24: 10GBASE-E (10GBASE-ER and 10GBASE-EW) Optical Interface Specifications (*continued*)

Parameter	10GBASE-E
Average launch power	–4.7 through 4.0 dBm
Average receive power	–15.8 through –1.0 dBm
Receiver saturation	–1.0 dBm
Receiver sensitivity (max) in OMA	–14.1 dBm

10GBASE-Z Specifications

Table 25 on page 39 shows the optical interface specifications for the 10GBASE-ZR and 10GBASE-ZW transceiver.

Table 25: 10GBASE-Z (10GBASE-ZR and 10GBASE-ZW) Optical Interface Specifications

Parameter	10GBASE-Z
Optical interface	Single-mode
Standard	Multivendor
Maximum distance	9/125 SMF cable: 80 km (49.6 miles)
Transmitter wavelength	1530 through 1565 nm 1528.77 through 1563.86 nm (tunable) for XFP-10G-CBAND-T50-ZR 1528.38 through 1568.77 nm (tunable) for SFPP-10G-CT50-ZR 1528.38 through 1568.77 nm (tunable) for SFPP-10G-DT-ZRC2
Average launch power	0 through 4.0 dBm for XENPAK-1XGE-ZR, XFP-10G-Z-OC192-LR2, and SFPP-10G-ZR-OTN-XT –1.0 through +3.0 dBm for XFP-10G-CBAND-T50-ZR 0 through 4.0 dBm for SFPP-10GE-ZR –1.0 through +3.0 dBm for SFPP-10G-CT50-ZR and SFPP-10G-DT-ZRC2

Table 25: 10GBASE-Z (10GBASE-ZR and 10GBASE-ZW) Optical Interface Specifications (*continued*)

Parameter	10GBASE-Z
Average receive power	–25.0 through –7.0 dBm for XENPAK-1XGE-ZR –23.0 through –7.0 dBm for XFP-10G-CBAND-T50-ZR –24.0 through –7.0 dBm for XFP-10G-Z-OC192-LR2 –24.0 through –7.0 dBm for SFPP-10GE-ZR –24.0 through –7.0 dBm for SFPP-10G-CT50-ZR –24.0 through –7.0 dBm (9.95, 10.312, and 10.709 Gbps) for SFPP-10G-DT-ZRC2 –24.0 through –7.0 dBm for SFPP-10G-ZR-OTN-XT
Receiver saturation	–7.0 dBm for XENPAK-1XGE-ZR, XFP-10G-CBAND-T50-ZR, XFP-10G-Z-OC192-LR2, SFPP-10G-CT50-ZR, SFPP-10G-DT-ZRC2, and SFPP-10G-ZR-OTN-XT –8.0 dBm for SFPP-10GE-ZR
Receiver sensitivity	–25.0 dBm for XENPAK-1XGE-ZR –23.0 dBm for XFP-10G-CBAND-T50-ZR –24.0 dBm for XFP-10G-Z-OC192-LR2 –24.0 dBm for SFPP-10GE-ZR –24.0 dBm for SFPP-10G-CT50-ZR For SFPP-10G-DT-ZRC2: –24.0 dBm (9.95, 10.312, and 10.709 Gbps, BER < 1×10^{-12}, no FEC) –25.0 dBm (11.049 and 11.095 Gbps, BER < 1×10^{-6}, pre-FEC) NOTE: When you use SFPP-10G-DT-ZRC2 in OTU1e (11.049 Gbps) or OTU2e (11.095 Gbps) applications, you must enable forward error correction (FEC) to achieve target receiver sensitivity. To enable FEC mode, use the fec command at the [edit interfaces <i>interface-name</i> otn-options] hierarchy level (see <i>fec</i>). –24.0 dBm for SFPP-10G-ZR-OTN-XT

Related Documentation

- Supported Network Interface Standards by Transceiver for ACX Series, M Series, MX Series, and T Series Routers on page 19

10-Gigabit Ethernet DWDM Optical Interface Specifications

The 10-Gigabit Ethernet DWDM PIC transceiver is supported on the M320 and T Series routers.

To determine which transceivers support the 10-Gigabit Ethernet DWDM optical interface specification, see [“Supported Network Interface Standards by Transceiver for ACX Series, M Series, MX Series, and T Series Routers” on page 19](#). The “Cables and connectors” section in the description for each MIC or PIC lists which standards and transceivers are supported for that device.

[Table 26 on page 41](#) shows the optical interface specifications for the 10-Gigabit Ethernet DWDM PIC transceiver.

Table 26: 10-Gigabit Ethernet DWDM LAN Rate Optical Interface Specifications

Parameter	Extra-Long Wavelength Serial DWDM, LAN Rate
Optical interface	Single-mode
Transceiver type	Dense wavelength division multiplexing (DWDM)
Standard	ITU-T G.694.1
Maximum distance	9/125 SMF cable: 49.6 miles (80 km)
Transmitter wavelength	1528.77 through 1563.86 nm, 100-GHz ITU grid
Average launch power	0 through 4.0 dBm
Transmit extinction ratio	9.0 dBm
Average receive power	–24.0 through –7.0 dBm
Receiver saturation	–7.0 dBm
Receiver sensitivity	–24.0 dBm

Related Documentation

- [Supported Network Interface Standards by Transceiver for ACX Series, M Series, MX Series, and T Series Routers on page 19](#)

10-Gigabit Ethernet DWDM Transceiver Wavelengths

[Table 27 on page 42](#) provides the supported wavelengths for the 100-GHz grid and the 50-GHz offset in both THz and nm.

Table 27: Programmable Wavelengths Supported by 10-Gigabit Ethernet DWDM Transceivers

100-GHz Grid		50-GHz Offset		100-GHz Grid		50-GHz Offset	
THz	nm	THz	nm	THz	nm	THz	nm
191.70	1563.86	191.75	1563.45	194.00	1545.32	194.05	1544.92
191.80	1563.04	191.85	1562.63	194.10	1544.52	194.15	1544.12
191.90	1562.23	191.95	1561.82	194.20	1543.73	194.25	1543.33
192.00	1561.41	192.05	1561.01	194.30	1542.93	194.35	1542.53
192.10	1560.60	192.15	1560.20	194.40	1542.14	194.45	1541.74
192.20	1559.79	192.25	1559.38	194.50	1541.34	194.55	1540.95
192.30	1558.98	192.35	1558.57	194.60	1540.55	194.65	1540.16
192.40	1558.17	192.45	1557.76	194.70	1539.76	194.75	1539.37
192.50	1557.36	192.55	1556.95	194.80	1538.97	194.85	1538.58
192.60	1556.55	192.65	1556.15	194.90	1538.18	194.95	1537.79
192.70	1555.74	192.75	1555.34	195.00	1537.39	195.05	1537.00
192.80	1554.94	192.85	1554.53	195.10	1536.60	195.15	1536.21
192.90	1554.13	192.95	1553.73	195.20	1535.82	195.25	1535.42
193.00	1553.32	193.05	1552.92	195.30	1535.03	195.35	1534.64
193.10	1552.52	193.15	1552.12	195.40	1534.25	195.45	1533.85
193.20	1551.72	193.25	1551.31	195.50	1533.46	195.55	1533.07
193.30	1550.91	193.35	1550.51	195.60	1532.68	195.65	1532.28
193.40	1550.11	193.45	1549.71	195.70	1531.89	195.75	1531.50
193.50	1549.31	193.55	1548.91	195.80	1531.11	195.85	1530.72
193.60	1548.51	193.65	1548.11	195.90	1530.33	195.95	1529.94
193.70	1547.71	193.75	1547.31	196.00	1529.55	196.05	1529.16
193.80	1546.91	193.85	1546.51	196.10	1528.77		
193.90	1546.11	193.95	1545.72				

- Related Documentation**
- [Ethernet DWDM Interface Wavelength Overview](#)
 - [Configuring the 10-Gigabit or 100-Gigabit Ethernet DWDM Interface Wavelength](#)
 - [Network Cable and Transceiver Overview for ACX Series, M Series, and MX Series Routers](#)
 - [Supported Network Interface Standards by Transceiver for ACX Series, M Series, MX Series, and T Series Routers on page 19](#)

40-Gigabit Ethernet 40GBASE-R Optical Interface Specifications

To determine which transceivers support each 40GBASE-R standard, see “[Supported Network Interface Standards by Transceiver for ACX Series, M Series, MX Series, and T Series Routers](#)” on page 19. The “Cables and Connectors” section in the description for each MIC or PIC lists which standards and transceivers are supported for that device.

The specifications are organized by distance supported.

- [40GBASE-SR4 Specifications on page 43](#)
- [40GBASE-LX4 Specifications on page 44](#)
- [40GBASE-LR4 Specifications on page 45](#)
- [40GBASE-ER4 Specifications on page 45](#)

40GBASE-SR4 Specifications

Table 28 on page 43 shows the optical interface specifications for the 40GBASE-SR4 standard.

Table 28: 40GBASE-SR4 Optical Interface Specifications

Parameter	40GBASE-SR4
Optical interface	Multimode
Standard	IEEE 802.3ba-2010
Maximum distance	OM3 MMF cable, 100 m (328 ft) OM4 MMF cable, 150 m (492 ft)
Transmitter wavelength per lane	840 through 860 nm
Average launch power per lane	−7.6 through 2.4 dBm
Average receive power per lane	−9.5 through 2.4 dBm
Stressed receiver sensitivity (OMA) per lane (maximum)	−5.4 dBm

40GBASE-LX4 Specifications

Table 29 on page 44 shows the optical interface specifications for the Juniper Networks proprietary 40GBASE-LX4.

Table 29: 40GBASE-LX4 Optical Interface Specifications

Parameter	40GBASE-LX4	
Signaling rate, each lane (range)	10.3125 GBd +/-100 ppm	
Connector type	Dual LC/PC	
Fiber pairs	1	
Transmit and receive lane wavelengths	Lane 0–1264.5 nm through 1277.5 nm	
	Lane 1–1284.5 nm through 1297.5 nm	
	Lane 2–1304.5 nm through 1317.5 nm	
	Lane 3–1324.5 nm through 1337.5 nm	
Average transmit launch power, each lane (minimum)	SMF	-9.0 dBm
	MMF	-7.0 dBm
Average transmit launch power, each lane (maximum)	SMF	2.3 dBm
	MMF	4.3 dBm
Average receive power, each lane (minimum)	SMF	-12 dBm
	MMF	-10.0 dBm
Average receive power, each lane (maximum)	SMF	2.3 dBm
	MMF	4.3 dBm
Receiver sensitivity (OMA), each lane (maximum)	SMF	-10.5 dBm
	MMF	-10.5 dBm

Table 29: 40GBASE-LX4 Optical Interface Specifications (*continued*)

Parameter	40GBASE-LX4			
Fiber type	SMF	MMF	MMF	
Core/cladding size	9/125 μm	50/125 μm	50/125 μm	
Fiber grade	OS1	OM3	OM4	
Effective modal bandwidth at 850 nm	–	2000 MHz x km	4700 MHz x km	
Operating distance	2 km (1.24 miles)	100 m (328 ft)	150 m (492 ft)	

40GBASE-LR4 Specifications

Table 30 on page 45 shows the optical interface specifications for the 40GBASE-LR4 standard.

Table 30: 40GBASE-LR4 Optical Interface Specifications

Parameter	40GBASE-LR4
Optical interface	Single mode
Standard	IEEE 802.3ba-2010
Maximum distance	9/125 SMF cable: 10 km (6.2 miles)
Transmitter wavelength per lane	1264.5 through 1277.5 nm 1284.5 through 1297.5 nm 1304.5 through 1317.5 nm 1324.5 through 1337.5 nm
Average launch power per lane	–7 through 2.3 dBm
Total average launch power (maximum)	8.3 dBm
Average receive power per lane	–13.7 through 2.3 dBm
Receiver sensitivity (OMA) per lane (maximum)	–11.5 dBm

40GBASE-ER4 Specifications

Table 31 on page 46 shows the optical interface specifications for the 40GBASE-ER4 standard.

Table 31: 40GBASE-ER4 Optical Interface Specifications

Parameter	40GBASE-ER4
Optical interface	Single mode
Standard	IEEE 802.3bm-2015
Maximum distance	9/125 SMF cable: 40 km (24.8 miles)
Transmitter wavelength per lane	1264.5 through 1277.5 nm 1284.5 through 1297.5 nm 1304.5 through 1317.5 nm 1324.5 through 1337.5 nm
Average launch power per lane	-2.7 through 4.5 dBm
Total average launch power (maximum)	4.5 dBm
Average receive power per lane	-21.2 through -4.5 dBm
Receiver sensitivity (OMA) per lane (maximum)	-19 dBm

SONET/SDH OC3/STM1 Optical Interface Specifications

The SONET/SDH OC3/STM1 standards are supported on M Series routers, MX Series routers, and T Series routers.

To determine which transceivers support each SONET/SDH OC3/STM1 standard, see [“Supported Network Interface Standards by Transceiver for ACX Series, M Series, MX Series, and T Series Routers” on page 19](#). The “Cables and connectors” section in the description for each MIC or PIC lists which standards and transceivers are supported for that device.

The specifications are organized by distance supported.

- [SONET/SDH OC3/STM1 Specifications on page 46](#)
- [SONET/SDH OC3/STM1 Intermediate Reach \(IR-1\) Specifications on page 47](#)
- [SONET/SDH OC3/STM1 Long Reach \(LR-1\) Specifications on page 47](#)

SONET/SDH OC3/STM1 Specifications

[Table 32 on page 47](#) shows the multimode SONET/SDH OC3/STM1 optical interface specifications.

Table 32: SONET/SDH OC3/STM1 Multimode Optical Interface Specifications

Parameter	Multimode
Optical interface	Multimode
Maximum distance	MMF cable: 1.2 miles (2 km)
Standard	Multivendor agreement
Transmitter wavelength	1270 through 1380 nm
Average launch power	–20 through –14 dBm
Receiver saturation	–14 dBm
Receiver sensitivity	–30 dBm

SONET/SDH OC3/STM1 Intermediate Reach (IR-1) Specifications

Table 33 on page 47 shows the SONET/SDH OC3/STM1 intermediate reach (IR-1) optical interface specifications.

Table 33: SONET/SDH OC3/STM1 Intermediate Reach Optical Interface Specifications

Parameter	Intermediate Reach (IR-1)
Optical interface	Single-mode
Maximum distance	SMF cable: 9.3 miles (15 km)
Standard	Telcordia GR-253
Transmitter wavelength	1261 through 1360 nm
Average launch power	–15 through –8 dBm
Receiver saturation	–8 dBm
Receiver sensitivity	–28 dBm

SONET/SDH OC3/STM1 Long Reach (LR-1) Specifications

Table 34 on page 48 shows the SONET/SDH OC3/STM1 long reach (LR-1) optical interface specifications.

Table 34: SONET/SDH OC3/STM1 Long Reach -1 Optical Interface Specifications

Parameter	Long Reach (LR-1)
Optical interface	Single-mode
Maximum distance	SMF cable: 24.85 miles (40 km)
Standard	Telcordia GR-253
Transmitter wavelength	1263 through 1360 nm
Average launch power	-5 through 0 dBm
Receiver saturation	-10 dBm
Receiver sensitivity	-34 dBm

- Related Documentation**
- [Supported Network Interface Standards by Transceiver for ACX Series, M Series, MX Series, and T Series Routers on page 19](#)

SONET/SDH OC12/STM4 Optical Interface Specifications

The SONET/SDH OC12/STM4 optical interface standards are supported on M Series routers, MX Series routers, and T Series routers.

To determine which transceivers support each SONET/SDH OC12/STM4 standard, see “Supported Network Interface Standards by Transceiver for ACX Series, M Series, MX Series, and T Series Routers” on page 19. The “Cables and connectors” section in the description for each MIC or PIC lists which standards and transceivers are supported for that device.

The specifications are organized by distance supported.

- [SONET/SDH OC12/STM4 Short Reach \(SR-1\) Specifications on page 48](#)
- [SONET/SDH OC12/STM4 Intermediate Reach \(IR-1\) Specifications on page 49](#)
- [SONET/SDH OC12/STM4 Long Reach \(LR-1\) Specifications on page 49](#)
- [SONET/SDH OC12/STM4 Long Reach \(LR-2\) Specifications on page 50](#)

SONET/SDH OC12/STM4 Short Reach (SR-1) Specifications

Table 35 on page 49 shows the SONET/SDH OC12/STM4 short reach (SR-1) optical interface specifications.

Table 35: SONET/SDH OC12/STM4 Short Reach (SR-1) Optical Interface Specifications

Parameter	Short Reach (SR-1)
Optical interface	Single-mode
Maximum distance	SMF cable: 1.24 miles (2 km)
Standard	Telcordia GR-253
Transmitter wavelength	1261 through 1360 nm
Average launch power	–15 through –8 dBm
Receiver saturation	–8 dBm
Receiver sensitivity	–23 dBm

SONET/SDH OC12/STM4 Intermediate Reach (IR-1) Specifications

Table 36 on page 49 shows the SONET/SDH OC12/STM4 short reach (IR-1) optical interface specifications.

Table 36: SONET/SDH OC12/STM4 Intermediate Reach (IR-1) Optical Interface Specifications

Parameter	Intermediate Reach (IR-1)
Optical interface	Single-mode
Maximum distance	SMF cable: 9.3 miles (15 km)
Standard	Telcordia GR-253
Transmitter wavelength	1274 through 1356 nm
Average launch power	–15 through –8 dBm
Receiver saturation	–8 dBm
Receiver sensitivity	–28 dBm

SONET/SDH OC12/STM4 Long Reach (LR-1) Specifications

Table 37 on page 50 shows the SONET/SDH OC12/STM4 short reach (LR-1) optical interface specifications.

Table 37: SONET/SDH OC12/STM4 Long Reach (LR-1) Optical Interface Specifications

Parameter	Long Reach (LR-1)
Optical interface	Single-mode
Maximum distance	SMF cable: 24.85 miles (40 km)
Standard	Telcordia GR-253
Transmitter wavelength	1280 through 1335 nm
Average launch power	–3 through +2 dBm
Receiver saturation	–8 dBm
Receiver sensitivity	–28 dBm

SONET/SDH OC12/STM4 Long Reach (LR-2) Specifications

Table 38 on page 50 shows the SONET/SDH OC12/STM4 short reach (LR-2) optical interface specifications.

Table 38: SONET/SDH OC12/STM4 Long Reach (LR-2) Optical Interface Specifications

Parameter	Long Reach (LR-2)
Optical interface	Single-mode
Maximum distance	SMF cable: 49.70 miles (80 km)
Standard	Telcordia GR-253
Transmitter wavelength	1480 through 1580 nm
Average launch power	–3 through 2 dBm
Receiver saturation	–8 dBm
Receiver sensitivity	–28 through –8 dBm

Related Documentation

- [Supported Network Interface Standards by Transceiver for ACX Series, M Series, MX Series, and T Series Routers on page 19](#)

SONET/SDH OC48/STM16 Optical Interface Specifications

The SONET/SDH OC48/STM16 standards are supported on M40e routers, M120 routers, M320 routers, MX Series routers, and T Series routers.

To determine which transceivers support each SONET/SDH OC48/STM16 standard, see “Supported Network Interface Standards by Transceiver for ACX Series, M Series, MX Series, and T Series Routers” on page 19. The “Cables and connectors” section in the description for each MIC or PIC lists which standards and transceivers are supported for that device.

The specifications are organized by distance supported.

- [SONET/SDH OC48/STM16 Short Reach \(SR-1\) Specifications on page 51](#)
- [SONET/SDH OC48/STM16 Intermediate Reach \(IR-1\) Specifications on page 51](#)
- [SONET/SDH OC48/STM16 Long Reach \(LR-1\) Specifications on page 52](#)
- [SONET/SDH OC48/STM16 Long Reach \(LR-2\) Specifications on page 52](#)

SONET/SDH OC48/STM16 Short Reach (SR-1) Specifications

[Table 39 on page 51](#) shows the SONET/SDH OC48/STM16 short reach (SR-1) optical interface specifications.

Table 39: SONET/SDH OC48/STM16 Short Reach (SR-1) Optical Interface Specifications

Parameter	Short Reach (SR-1)
Optical interface	Single-mode
Maximum distance	SMF cable: 1.24 miles (2 km)
Standard	Telcordia GR-253
Transmitter wavelength	1266 through 1360 nm
Average launch power	–10 through –3 dBm
Receiver saturation	–3 dBm
Receiver sensitivity	–18 dBm

SONET/SDH OC48/STM16 Intermediate Reach (IR-1) Specifications

[Table 40 on page 52](#) shows the SONET/SDH OC48/STM16 intermediate reach (IR-1) optical interface specifications.

Table 40: SONET/SDH OC48/STM16 Intermediate Reach (IR-1) Optical Interface Specifications

Parameter	Intermediate Reach (IR-1)
Optical interface	Single-mode
Maximum distance	SMF cable: 9.3 miles (15 km)
Standard	Telcordia GR-253
Transmitter wavelength	1260 through 1360 nm
Average launch power	–5 through 0 dBm
Receiver saturation	0 dBm
Receiver sensitivity	–18 dBm

SONET/SDH OC48/STM16 Long Reach (LR-1) Specifications

Table 41 on page 52 shows the SONET/SDH OC48/STM16 long reach (LR-1) optical interface specifications.

Table 41: SONET/SDH OC48/STM16 Long Reach (LR-1) Optical Interface Specifications

Parameter	Long Reach (LR-1)
Optical interface	Single-mode
Maximum distance	SMF cable: 28.85 miles (40 km)
Standard	Telcordia GR-253
Transmitter wavelength	1280 through 1335 nm
Average launch power	–2 through +3 dBm
Receiver saturation	–9 dBm
Receiver sensitivity	–28 dBm

SONET/SDH OC48/STM16 Long Reach (LR-2) Specifications

Table 42 on page 53 shows the SONET/SDH OC48/STM16 long reach (LR-2) optical interface specifications.

Table 42: SONET/SDH OC48/STM16 Long Reach (LR-2) Optical Interface Specifications

Parameter	Long Reach (LR-2)
Optical interface	Single-mode
Maximum distance	SMF cable: 49.71 miles (80 km)
Standard	Telcordia GR-253
Transmitter wavelength	1500 through 1580 nm
Average launch power	-2 through +3 dBm
Receiver saturation	-9 dBm
Receiver sensitivity	-28 dBm

Related Documentation

- [Supported Network Interface Standards by Transceiver for ACX Series, M Series, MX Series, and T Series Routers on page 19](#)

SONET/SDH OC192/STM64 Optical Interface Specifications

The SONET/SDH OC192/STM64 standards are supported on M120 routers, M320 routers, MX Series routers, and T Series routers.

To determine which transceivers support the SONET/SDH OC192/STM64 standard, see “Supported Network Interface Standards by Transceiver for ACX Series, M Series, MX Series, and T Series Routers” on page 19. The “Cables and connectors” section in the description for each MIC or PIC lists which standards and transceivers are supported for that device.

The specifications are organized by distance supported.

- [SONET/SDH OC192/STM64 Very Short Reach \(VSR\) on page 53](#)
- [SONET/SDH OC192/STM64 Short Reach \(SR-1\) on page 54](#)
- [SONET/SDH OC192/STM64 Short Reach \(SR-2\) on page 54](#)
- [SONET/SDH OC192/STM64 Intermediate Reach \(IR-2\) on page 55](#)
- [SONET/SDH OC192/STM64 Long reach \(LR-1\) on page 55](#)
- [SONET/SDH OC192/STM64 Long reach \(LR-2\) on page 56](#)

SONET/SDH OC192/STM64 Very Short Reach (VSR)

[Table 43 on page 54](#) shows the SONET/SDH OC192/STM64 very short reach (VSR) optical interface specifications.

Table 43: SONET/SDH OC192/STM64 Very Short Reach (VSR 1) Optical Interface Specifications

Parameter	Very Short Reach (VSR)
Optical interface	Multimode
Maximum distance	MMF cable: 984.25 feet (300 m)
Standard	OIF VSR4–1
Transmitter wavelength	830 through 860 nm
Average launch power	–10 through –3 dBm
Receiver saturation	–3 dBm
Receiver sensitivity	–16 dBm

SONET/SDH OC192/STM64 Short Reach (SR-1)

Table 44 on page 54 shows the SONET/SDH OC192/STM64 short reach (SR-1) optical interface specifications.

Table 44: SONET/SDH OC192/STM64 Short Reach (SR-1) Optical Interface Specifications

Parameter	Short Reach (SR-1)
Optical interface	Single-mode
Maximum distance	SMF cable: 6.21 miles (10 km)
Standard	Telcordia GR-253 OC192 SR1
Transmitter wavelength	1290 nm through 1330 nm
Average launch power	–6 through –1 dBm
Receiver saturation	–1.0 dBm
Receiver sensitivity	–11 dBm

SONET/SDH OC192/STM64 Short Reach (SR-2)

Table 45 on page 55 shows the SONET/SDH OC192/STM64 short reach (SR-2) optical interface specifications.

Table 45: SONET/SDH OC192/STM64 Short Reach (SR-2) Optical Interface Specifications

Parameter	Short Reach (SR-2)
Optical interface	Single-mode
Maximum distance	SMF cable: 15.5 miles (25 km)
Standard	Telcordia GR-253 OC192 SR2
Transmitter wavelength	1530 through 1565 nm
Average launch power	–4 through 0 dBm
Receiver saturation	–3 dBm
Receiver sensitivity	–14 dBm

SONET/SDH OC192/STM64 Intermediate Reach (IR-2)

Table 46 on page 55 shows the SONET/SDH OC192/STM64 Intermediate reach (IR-2) optical interface specifications.

Table 46: SONET/SDH OC192/STM64 Intermediate Reach (IR-2) Optical Interface Specifications

Parameter	Intermediate Reach (IR-2)
Optical interface	Single-mode
Maximum distance	SMF cable: 24.8 miles (40 km) NOTE: Distances greater than 30 km are considered to be engineered links.
Standard	Telcordia GR-253 OC192 IR2
Transmitter wavelength	1530 nm through 1565 nm
Average launch power	–1.0. through 2 dBm
Receiver saturation	–1.0 dBm
Receiver sensitivity	–14 dBm

SONET/SDH OC192/STM64 Long reach (LR-1)

Table 47 on page 56 shows the SONET/SDH OC192/STM64 long reach (LR-1) optical interface specifications.

Table 47: SONET/SDH OC192/STM64 Long Reach (LR-1) Optical Interface Specifications

Parameter	Long Reach (LR-1)
Optical interface	Single-mode
Maximum distance	SMF cable: 49.71 miles (80 km)
Standard	Telcordia GR-253 OC192 LR2
Transmitter wavelength	1530 nm through 1565 nm
Average launch power	6 through 8 dBm
Receiver saturation	-10 dBm
Receiver sensitivity	-22 dBm

SONET/SDH OC192/STM64 Long reach (LR-2)

Table 48 on page 56 shows the SONET/SDH OC192/STM64 long reach (LR-2) optical interface specifications.

Table 48: SONET/SDH OC192/STM64 Long Reach (LR-2) Optical Interface Specifications

Parameter	Long Reach (LR-2)
Optical interface	Single-mode
Maximum distance	SMF cable: 49.71 miles (80 km)
Standard	Telcordia GR-253 OC192 LR2
Transmitter wavelength	1530 nm through 1565 nm
Average launch power	0 through 4 dBm
Receiver saturation	-7 dBm
Receiver sensitivity	-24 dBm

Related Documentation

- [Supported Network Interface Standards by Transceiver for ACX Series, M Series, MX Series, and T Series Routers on page 19](#)

SONET/SDH OC768/STM256 Optical Interface Specifications

The SONET/SDH OC768/STM256 PIC is supported on T640 routers, T1600 routers, and T4000 routers. This PIC has a fixed SONET/SDH OC768/STM256 short reach (SR-1) optical interface.

To determine which transceivers support each SONET/SDH OC768/STM256 standard, see [“Supported Network Interface Standards by Transceiver for ACX Series, M Series, MX Series, and T Series Routers” on page 19](#). The “Cables and connectors” section in the description for each PIC lists which standards and transceivers are supported for that device.

[Table 49 on page 57](#) shows the SONET/SDH OC768/STM256 short reach (SR-1) optical interface specifications.

Table 49: SONET/SDH OC768/STM256 Short Reach (SR-1) Optical Interface Specifications

Parameter	Short Reach (SR-1)
Optical interface	Single-mode
Maximum distance	1.24 miles (2 km)
Standard	300-pin multi-source agreement (MSA) ITU G.693 VSR2000–3R2
Transmitter wavelength	1530 through 1565 nm
Average launch power	0 through +3 dBm
Receiver saturation	+3 dBm
Receiver sensitivity	–6 dBm

Related Documentation

- [Supported Network Interface Standards by Transceiver for ACX Series, M Series, MX Series, and T Series Routers on page 19](#)

PART 2

PIC Descriptions

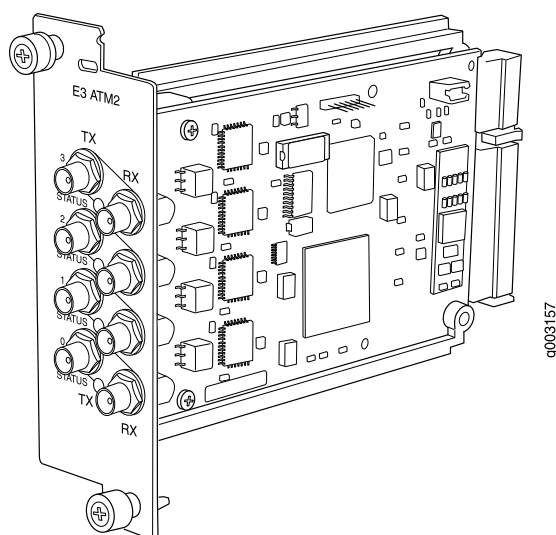
- [ATM2 IQ PIC Descriptions on page 61](#)
- [Channelized IQ PIC Descriptions on page 73](#)
- [Channelized Enhanced IQ \(IQE\) PIC Descriptions on page 79](#)
- [DS3 and E3 PIC Descriptions on page 101](#)
- [Fast Ethernet and Gigabit Ethernet PIC Descriptions on page 107](#)
- [Ethernet IQ PIC Descriptions on page 113](#)
- [Ethernet IQ2 PIC Descriptions on page 117](#)
- [Ethernet Enhanced IQ2 \(IQ2E\) PIC Descriptions on page 123](#)
- [10-Gigabit Ethernet PIC Descriptions on page 129](#)
- [40-Gigabit Ethernet PIC Descriptions on page 141](#)
- [Services PIC Descriptions on page 145](#)
- [SONET/SDH PIC Descriptions on page 153](#)
- [End-of-Life PIC Descriptions on page 185](#)

CHAPTER 3

ATM2 IQ PIC Descriptions

- ATM2 E3 IQ PIC (T640 Router) on page 61
- ATM2 OC3/STM1 IQ PIC (T640 Router) on page 63
- ATM2 OC12/STM4 IQ PICs (T640 Router) on page 66
- ATM2 OC48/STM16 IQ PIC with SFP (T640 Router) on page 69

ATM2 E3 IQ PIC (T640 Router)

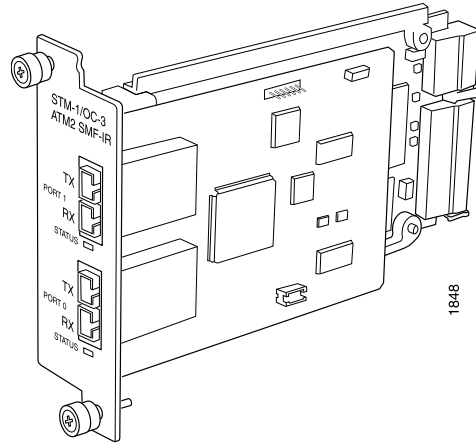


Software release	• Junos OS Release 7.4 and later (Type 1) For information on which FPCs support this PIC, see “T640 PIC/FPC Compatibility” on page 12.
Description	• Four E3 ports • Power requirement: 0.41 A @ 48 V (20 W) • Fine-grained queuing per logical interface • ATM standards compliant • Model number: PB-4E3-ATM2

Hardware features	• 16-MB SDRAM memory for ATM segmentation and reassembly (SAR) • ATM switch ID • Configurable framing options: • G.751 direct mapping • G.751 with PLCP encapsulation (default) • G.832 ATM direct mapping • Internal and loop timing
Software features	• Per-virtual circuit (VC) and per-virtual path (VP) traffic shaping • Unspecified bit rate (UBR) traffic shaping • Fine-grained variable bit rate (VBR) traffic shaping • Circuit cross-connect (CCC) • ATM Inverse Address Resolution Protocol (ARP), which enables routers to automatically learn the IP address of the router on the far end of an ATM permanent virtual circuit (PVC) • Simple Network Management Protocol (SNMP): • Management Information Base (MIB) 2 (RFC 1213) • ATM MIB (RFC 1695) • SONET MIB • AAL5 encapsulations: • ATM-VC-MUX • ATM-NLPID • ATM-Cisco-LLPID • ATM-SNAP • ATM-CCC-VC-MUX
Cables and connectors	• 10 ft (3.05 m) posilock SMB to BNC (provided) • Four pairs of Rx and Tx coaxial cables
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure
Alarms, errors, and events	• Alarm indication signal (AIS) • Frame error • Line code violation • Local and remote loopback • Loss of signal (LOS) • Out of frame (OOF) • Yellow alarm

- Related Documentation**
- *T640 PIC Description*
 - *T640 PIC Combination Limitations*
 - [T640 PICs Supported on page 3](#)

ATM2 OC3/STM1 IQ PIC (T640 Router)



Software release	Junos OS Release 7.6 and later (Type 1) For information on which FPCs support this PIC, see “T640 PIC/FPC Compatibility” on page 12.
Description	- Two OC3 ports - Power requirement: 0.41 A @ 48 V (20 W) - Fine-grained queuing per logical interface - Conforms to ANSI T1.105-1991 and T1E1.2/93-020R1 - ATM and SONET/SDH standards compliant - Alarm and event counting and detection - Compatible with well-known ATM switches - ATM switch ID, which displays the switch IP address and local interface name of the adjacent Fore ATM switches - Model number: PB-2OC3-STM2-MM
Hardware features	- Single 3010 SAR for segmentation and reassembly into 53 byte ATM cells - High-performance parsing of SONET/SDH frames - ASIC-based packet segmentation and reassembly (SAR) management and output port queuing 64 MB SDRAM memory for ATM SAR - Packet buffering, Layer 2 parsing

Software features	• Circuit cross-connect (CCC) for leveraging ATM access networks • User-configurable virtual circuit (VC) and virtual path (VP) support • Support for idle cell or unassigned cell transmission • OAM fault management processes alarm indication signal (AIS), remote defect indication (RDI) cells, and loop cells • Point-to-point and point-to-multipoint mode Layer 2 counters per VC and per VP • Local and remote loopback • ATM Inverse Address Resolution Protocol (ARP), which enables routers to automatically learn the IP address of the router on the far end of an ATM permanent virtual circuit (PVC) • Simple Network Management Protocol (SNMP): • Management Information Base (MIB) 2 (RFC 1213) • ATM MIB (RFC 1695) • SONET MIB • Unspecified bit rate (UBR), non-real-time variable bit rate (VBR), and constant bit rate (CBR) traffic shaping • Per-VC or per-VP traffic shaping • Support for F4 OAM cells • Support for 16 bit VCI range
Cables and connectors	• Duplex SC/PC connector (RX and TX) • SONET/SDH OC3/STM1 fixed transceivers: • Multimode • Intermediate reach (IR-1) Optical interface specifications—see “SONET/SDH OC3/STM1 Optical Interface Specifications” on page 46
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events

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

Related Documentation

- *T640 PIC Description*
- *T640 PIC Combination Limitations*
- [T640 PICs Supported on page 3](#)

ATM2 OC12/STM4 IQ PICs (T640 Router)

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

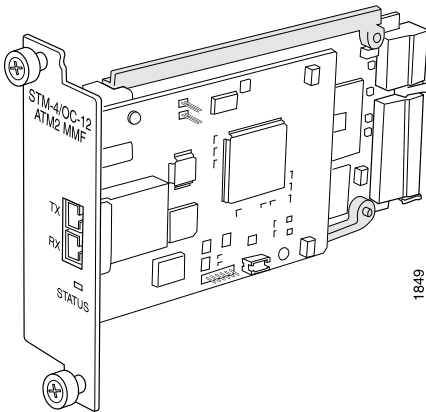
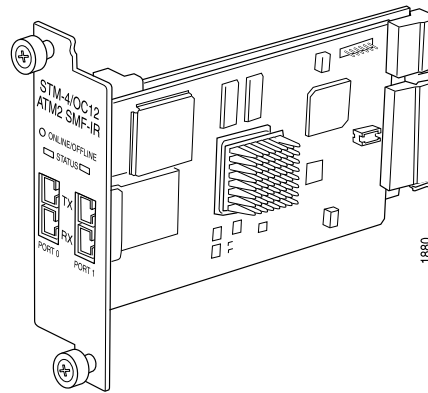


Figure 2: 2-Port ATM2 OC12/STM4 IQ PIC



Software release

- 1-port: Junos OS Release 8.0 and later (Type 1)
- 2-port: Junos OS Release 5.5 and later (Type 2)

For information on which FPCs support these PICs, see ["T640 PIC/FPC Compatibility"](#) on page 12.

Description

- One or two OC12 ports
- Power requirement: 0.52 A @ 48 V (25 W)
- Fine-grained queuing per logical interface
- Conforms to ANSI T1.105-1991 and T1E1.2/93-020R1
- Complies with ATM and SONET/SDH standards
- Alarm and event counting and detection
- Compatible with well-known ATM switches
- ATM switch ID, which displays the switch IP address and local interface name of the adjacent Fore ATM switches
- Model number: PB-2OC12-ATM2-MM

Hardware features

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

Software features	• Circuit cross-connect for leveraging ATM access networks • User-configurable virtual circuit (VC) and virtual path (VP) support • Support for idle cell or unassigned cell transmission • OAM fault management processes alarm indication signal (AIS), remote defect indication (RDI), and loop cells • Point-to-point and point-to-multipoint mode Layer 2 counters per VC and per VP • Local and remote loopback • ATM Inverse ARP, which enables routers to automatically learn the IP address of the router on the far end of an ATM PVC • Simple Network Management Protocol (SNMP): • Management Information Base (MIB) 2 (RFC 1213) • ATM MIB (RFC 1695) • SONET MIB • Unspecified bit rate (UBR), non-real-time variable bit rate (VBR), and constant bit rate (CBR) traffic shaping • Per-VC or per-VP traffic shaping • Support for F4 OAM cells • Support for 16-bit VCI range
Cables and connectors	• Duplex SC/PC connector (Rx and Tx) • SONET/SDH OC12/STM4 fixed transceivers: • Multimode • Intermediate reach (IR-1) Optical interface specifications—see “SONET/SDH OC12/STM4 Optical Interface Specifications” on page 48
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

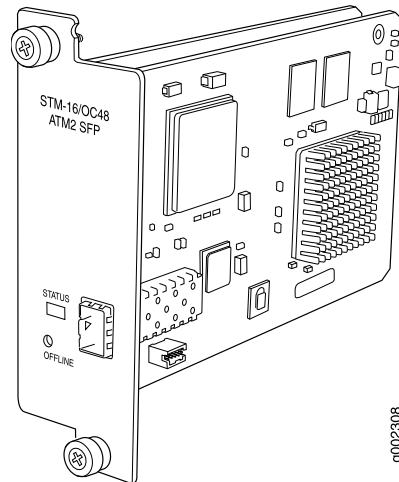
Alarms, errors, and events

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

**Related
Documentation**

- *T640 PIC Description*
- *T640 PIC Combination Limitations*
- [T640 PICs Supported on page 3](#)

ATM2 OC48/STM16 IQ PIC with SFP (T640 Router)



Software release	Junos OS Release 7.3 and later (Type 2) For information on which FPCs support this PIC, see “T640 PIC/FPC Compatibility” on page 12.
Description	- One OC48 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 - 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 - Model number: PB-1OC48-ATM2-SFP
Hardware features	- ATM2 IQ 1-port OC48 PICs have one 3010 SAR for segmentation and reassembly into 53-byte ATM cells. - High-performance parsing of SONET/SDH frames - ASIC-based packet segmentation and reassembly (SAR) management and output port queuing 64-MB SDRAM memory for ATM SAR - Packet buffering, Layer 2 parsing

Software features	• Multiprotocol Label Switching (MPLS) circuit cross-connect for leveraging ATM access networks • User-configurable virtual circuit (VC) and virtual path (VP) support • Support for idle cell or unassigned cell transmission • OAM fault management processes alarm indication signal (AIS), remote defect indicator (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	• You can install different transceivers on the PIC. • Duplex LC/PC connector (RX and TX) • SONET/SDH OC48/STM16 fiber-optic SFP transceivers: • Multimode (model number: SFP-1OC48-SR) • Intermediate reach (IR-1) (model number: SFP-1OC48-IR) Optical interface specifications—see “SONET/SDH OC48/STM16 Optical Interface Specifications” on page 51
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events

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

Related Documentation

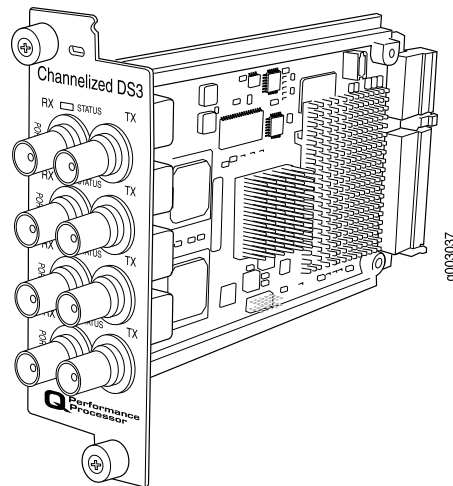
- *T640 PIC Description*
- *T640 PIC Combination Limitations*
- [T640 PICs Supported on page 3](#)

CHAPTER 4

Channelized IQ PIC Descriptions

- [Channelized DS3 IQ PIC \(T640 Router\) on page 73](#)
- [Channelized OC3 IQ PIC \(T640 Router\) on page 75](#)
- [Channelized STM1 IQ PIC \(T640 Router\) on page 77](#)

Channelized DS3 IQ PIC (T640 Router)

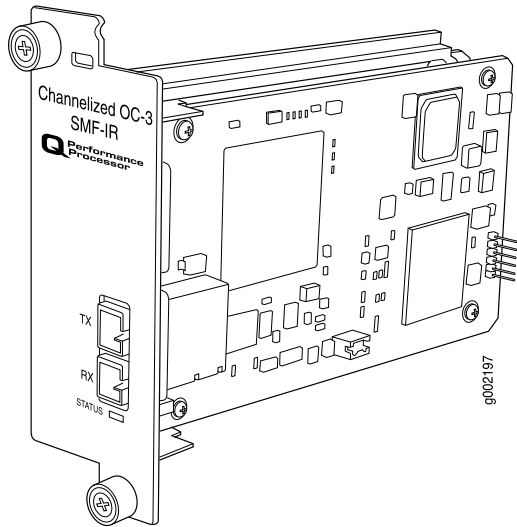


Software release	• Junos OS Release 8.0 and later (Type 1) For information on which FPCs support this PIC, see “T640 PIC/FPC Compatibility” on page 12.
Description	• Four DS3 ports • Power requirement: 0.32 A @ 48 V (15.6 W) • Fine-grained queuing per logical interface • Channelization: DS3, DS0 • Model number: PB-4CHDS3-QPP

Hardware features	• Data service unit (DSU) functionality • Subrate and scrambling: • Digital Link/Quick Eagle • Kentrox • Larscom • ADTRAN • Verilink • B3ZS line encoding • M13 or C-bit parity • Full bit error rate test (BERT) • Local and remote loopback testing
Software features	• Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) • Simple Network Management Protocol (SNMP): DS1 MIB, DS3 MIB • Dynamic, arbitrary channel configuration • Encapsulations: • Circuit cross-connect (CCC) • Translational cross-connect (TCC) • Frame Relay • High-Level Data Link Control (HDLC) • Point-to-Point Protocol (PPP)
Cables and connectors	• Standard DS3 BNC coaxial cable interfaces
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure
Alarms, errors, and events	• Alarm indication signal (AIS) • Excessive zeros (EXZ) • Far-end block error (FEBE) • Frame error • Idle code, Idle received • Line code violation (LCV) • Loss of signal (LOS) • Out of frame (OOF) • Parity bit (P-bit) disagreements • Path parity error • Yellow alarm bit (X-bit) disagreements
Instrumentation (counters)	• Layer 2 per-queue and per-channel packet and byte counters

- Related Documentation
- [T640 PIC Description](#)
 - [T640 PIC Combination Limitations](#)
 - [T640 PICs Supported on page 3](#)

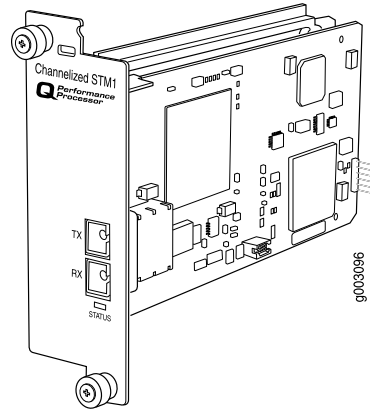
Channelized OC3 IQ PIC (T640 Router)



Software release	• Junos OS Release 7.6 and later (Type 1) For information on which FPCs support this PIC, see "T640 PIC/FPC Compatibility" on page 12.
Description	• One OC3 port • Power requirement: 0.39 A @ 48 V (18.6 W) • Fine-grained queuing per logical interface • Channelization: DS3, DS1, DS0 • Model number: PB-4CHDS3-QPP
Hardware features	• Subrate and scrambling: • Digital Link/Quick Eagle • Kentrox • Larscom • ADTRAN • Verilink • Packet buffering, Layer 2 parsing • M13/C-bit parity encoding • DS3 far-end alarm and control (FEAC) channel support • Local and remote loopback testing

Software features	• Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) • Simple Network Management Protocol (SNMP): OC3 MIB, DS3 MIB, T1 MIB • Dynamic, arbitrary channel configuration • Full bit error rate test (BERT) • Encapsulations: • Circuit cross-connect (CCC) • Translational cross-connect (TCC) • Frame Relay • High-Level Data Link Control (HDLC) • Point-to-Point Protocol (PPP)
Cables and connectors	• Duplex SC/PC connector (Rx and Tx); single-mode fiber intermediate-reach fiber • SONET/SDH OC3/STM1 fiber-optic SFP transceivers: • Intermediate reach (IR-1) (model number: SFP-OC3-IR) Optical interface specifications—see “SONET/SDH OC3/STM1 Optical Interface Specifications” on page 46
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure
Alarms, errors, and events	• Alarm indication signal (AIS-L, AIS-P) • Bit error rate signal degrade (BERR-SD), bit error rate signal fail (BERR-SF) • Bit interleaved parity errors B1, B2, B3 • Errored seconds (ES-S, ES-L, ES-P), far-end bit errors REI-L, REI-P (CV-LFE, CV-PFE), Far-end block error (FEBE), far-end errored seconds (ES-LFE, ES-PFE), far-end severely errored seconds (SES-LFE, SES-PFE), far-end unavailable seconds (UAS-LFE, UAS-PFE) • Frame error • Idle code, Idle received • Loss of frame (LOF), loss of pointer (LOP-P), loss of signal (LOS) • Out of frame (OOF) • Payload mismatch (PLM-P), payload unequipped (UNEQ-P) • Parity bit (P-bit) disagreements • Path parity error • Remote defect indication (RDI-L, RDI-P) • Severely errored framing (SEF), severely errored framing seconds (SEFS-S), severely errored seconds (SES-S, SES-L, SES-P), unavailable seconds (UAS-L, UAS-P) • Yellow alarm bit (X-bit) disagreements
Related Documentation	• <i>T640 PIC Description</i> • <i>T640 PIC Combination Limitations</i> • T640 PICs Supported on page 3

Channelized STM1 IQ PIC (T640 Router)



Software release	Junos OS Release 7.5 and later (Type 1) For information on which FPCs support this PIC, see “T640 PIC/FPC Compatibility” on page 12.
Description	- One STM1 port - Power requirement: 0.39 A @ 48 V (18.6 W) - Fine-grained queuing per logical interface - Channelization: STM1c, fractional E1, framed and unframed DS0 - Model number: PB-1CHSTM1-SMIR-QPP
Hardware features	- Packet buffering, Layer 2 parsing - Local and remote loopback testing
Software features	- Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) - SNMP: SONET/SDH MIB, T1/E1 MIB - Dynamic, arbitrary channel configuration - Full bit error rate test (BERT) patterns at E1 and DS0 levels - Encapsulations: - High-Level Data Link Control (HDLC) - Frame Relay - Circuit cross-connect (CCC) - Translational cross-connect (TCC) - Point-to-Point Protocol (PPP)
Cables and connectors	Duplex SC/PC connector (Rx and Tx); single-mode intermediate-reach fiber
LEDs	One tricolor per port: - Off—Not enabled - Green—Online with no alarms or failures - Yellow—Online with alarms for remote failures - Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events

- Alarm indication signal—line (AIS-L)
- Alarm indication signal—path (AIS-P)
- Bit error rate—signal degrade (BERR-SD)
- Bit error rate—signal fail (BERR-SF)
- Bit interleaved parity errors B1, B2, B3 (CV-S, CV-L, CV-P)
- Loss of frame (LOF)
- Loss of pointer (LOP-P)
- Loss of signal (LOS)
- Payload mismatch (PLM-P)
- Payload unequipped (unequipped STS at path level) (UNEQ-P)
- Remote defect indication—line (RDI-L)
- Remote defect indication—path (RDI-P)

Error detection:

- Errored seconds (ES-S, ES-L, ES-P)
- Far-end bit errors, remote error indication—line (REI-L), far-end line coding violations (CV-LFE)
- Far-end bit errors, remote error indication—path (REI-P), far-end path coding violations (CV-PFE)
- Far-end errored seconds (ES-LFE, ES-PFE)
- Far-end severely errored seconds (SES-LFE, SES-PFE)
- Far-end unavailable seconds (UAS-LFE, UAS-PFE)
- Severely errored framing (SEF)
- Severely errored framing seconds (SEFS-S)
- Severely errored seconds (SES-S, SES-L, SES-P)
- Unavailable seconds (UAS-L, UAS-P)

Instrumentation (counters)

- Layer 2 per-queue and per-channel packet and byte counters

Related Documentation

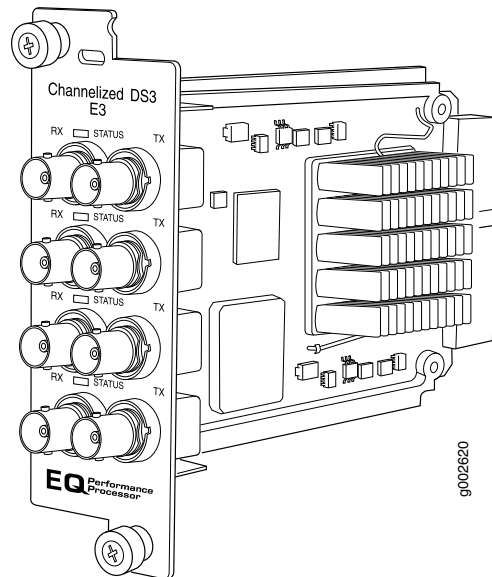
- *T640 PIC Description*
- *T640 PIC Combination Limitations*
- [T640 PICs Supported on page 3](#)

CHAPTER 5

Channelized Enhanced IQ (IQE) PIC Descriptions

- [Channelized DS3/E3 Enhanced IQ \(IQE\) PIC \(T640 Router\) on page 80](#)
- [Channelized E1/T1 Enhanced IQ \(IQE\) PIC \(T640 Router\) on page 83](#)
- [Channelized OC3/STM1 Enhanced IQ \(IQE\) PIC with SFP \(T640 Router\) on page 86](#)
- [Channelized OC12/STM4 Enhanced IQ \(IQE\) PICs with SFP \(T640 Router\) on page 91](#)
- [Channelized OC48/STM16 Enhanced IQ \(IQE\) PIC with SFP \(T640 Router\) on page 96](#)

Channelized DS3/E3 Enhanced IQ (IQE) PIC (T640 Router)



Software release	Junos OS Release 9.3R2 and later (Type 1) For information on which FPCs support this PIC, see “T640 PIC/FPC Compatibility” on page 12.
Description	- Four E3 or Channelized DS3 ports - E3 or Channelized DS3 is configurable on a per-port granularity - DS3 channelization: 4 DS3 channels 112 DS1 channels 1011 DS0 channels - Power requirement: 0.53 A @ 48 V (25.4 W) - Model number: PB-4DS3-E3-IQE-BNC
Hardware features	Ports are numbered 0 through 3 top to bottom
Software features	- Maximum transmission units (MTUs) of up to 9192 bytes - Dynamic, arbitrary channel configuration - Subrate and scrambling: NOTE: Only DS3 supports subrate and scrambling. - Digital Link/Quick Eagle - Kentrox - Larscom - ADTRAN - Verilink (subrate: only port A mode) NOTE: For DS3 interfaces, Verilink does not function if an IQE interface is paired with an IQ interface.

- Data service unit (DSU) functionality
- B3ZS line encoding
- Framing: M13, C-bit parity, framed clear channel
- Full bit error rate test (BERT) for DS0, DS1, and DS3
- ANSI T1.403 FDL
- Internal and loop clocking for DS3 and DS1
- DS3 far end alarm and control (FEAC) channel
- Local line, remote line, and remote playback loopback testing for each DS3 and DS1 channels
- Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)
- Enhanced fine-grained queuing per logical interface. See the *Class of Service Feature Guide for Routing Devices* for more information about class of service features.
- Simple Network Management Protocol (SNMP): DS1 MIB, DS3 MIB
- Encapsulations:
 - Circuit cross-connect (CCC)
 - Translational cross-connect (TCC)
 - Extended Frame Relay for CCC and TCC
 - Flexible Frame Relay
 - Frame Relay
 - Frame Relay for CCC
 - Frame Relay for TCC
 - Frame Relay port CCC
 - High-Level Data Link Control (HDLC)
 - HDLC framing for CCC
 - HDLC framing for TCC
 - MPLS CCC
 - MPLS TCC
 - Multilink Frame Relay (MLFR) UNI NNI (MFR FRF.16)
 - Point-to-Point Protocol (PPP)
 - PPP for CCC
 - PPP for TCC

Cables and connectors	• Standard DS3 BNC coaxial cable interfaces
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LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure
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Alarms, errors, and events

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

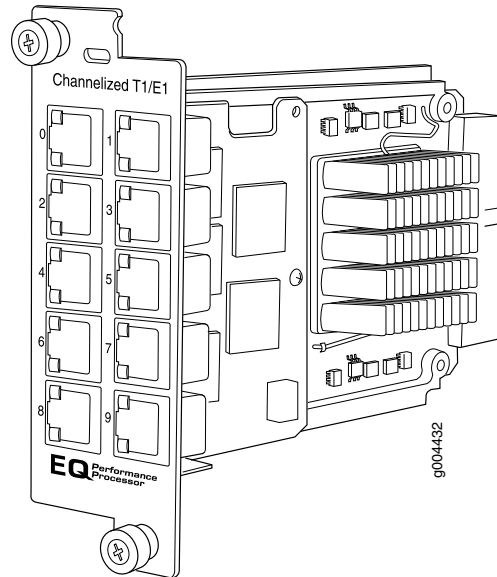
Instrumentation (counters)

- Layer 2 per-queue and per-channel packet and byte counters

Related Documentation

- *T640 PIC Description*
- *T640 PIC Combination Limitations*
- [T640 PICs Supported on page 3](#)

Channelized E1/T1 Enhanced IQ (IQE) PIC (T640 Router)



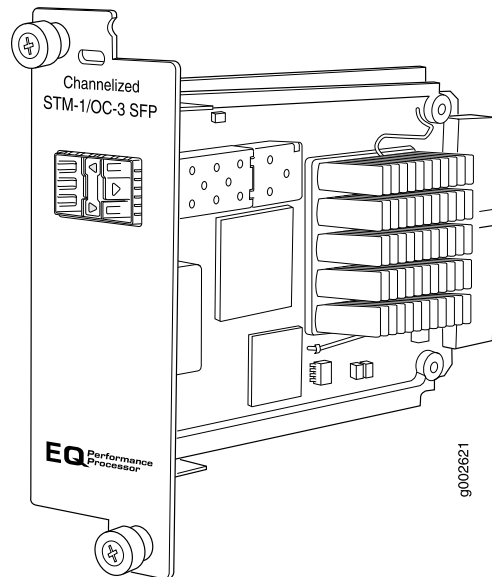
Software release	Junos OS Release 9.5 and later (Type 1) For information on which FPCs support this PIC, see “T640 PIC/FPC Compatibility” on page 12.
Description	- Ten E1 or T1 ports - DS1 and E1 interfaces are selectable on a per-port granularity - E1 channelization per PIC: 10 E1 channels 310 DS0 channels - T1 channelization per PIC: 10 T1 channels 240 DS0 channels - Power requirement: 0.52 A @ 48 V (24.73 W) - Model number: PB-10CHE1-T1-IQE-RJ48
Hardware features	Ports are numbered: - Top row: 0 and 1 from left to right - Second row: 2 and 3 from left to right - Third row: 3 and 4 from left to right - Bottom row: 5 and 6 from left to right
Software features	- Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) - Enhanced fine-grained queuing per logical interface. See the <i>Class of Service Feature Guide for Routing Devices</i> for more information about class of service features. - Support sending and receiving in-band loopback codes in both framed and unframed mode: - Framed in-band loopback at CSU - Framed in-band loopback at Smartjack (ANSI)

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

Cables and connectors	• 120-ohm RJ-48C connector (female)
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LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure
Alarms, errors, and events	• DSI alarms: • Alarm indication signal (AIS) • Loss of frame (LOF) • Remote alarm indication signal (RAIS) • 24-hour alarm reporting history maintained for error statistics and failure counts, 15-minute intervals on all errors • DSI error detection: • Bursty errored seconds (BES) • CRC errors • Errored seconds (ES) • Line errored seconds (LES) • Loss of framing seconds (LOFS) • Loss of signal seconds (LOSS) • Severely errored seconds (SES) • Severely errored framing seconds (SEFS) • Unavailable seconds (UAS)
Instrumentation (counters)	• Layer 2 per-queue and per-channel packet and byte counters • Layer 2 per-queue and per-channel packet and byte drop counters
Related Documentation	• <i>T640 PIC Description</i> • <i>T640 PIC Combination Limitations</i> • T640 PICs Supported on page 3

Channelized OC3/STM1 Enhanced IQ (IQE) PIC with SFP (T640 Router)



Software release	Junos OS Release 9.3 and later (Type 1) For information on which FPCs support this PIC, see “T640 PIC/FPC Compatibility” on page 12.
Description	- Two OC3 or STM1 ports - SONET or SDH is configurable on a per-port granularity - Channelization: OC3, DS3, DS1, DS0, E3, E1 - SONET channelization: 2 OC3 channels 6 DS3 channels 168 DS1 channels 1011 DS0 channels - SDH channelization: 2 STM1 channels (non-concatenated) 6 E3 channels 126 E1 channels 6 DS3 channels (Junos OS Release 10.1 and later) 168 DS1 channels (Junos OS Release 10.1 and later) 1011 DS0 channels - Power requirement: 0.56 A @ 48 V (27.1 W) - Model number: PB-1CHOC48-STM16-IQE-SFP
Hardware features	Ports are numbered 0 and 1 from left to right

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

- Cables and connectors
- Duplex SC/PC connector (Rx and Tx)
 - SONET/SDH OC3/STM1 fiber-optic SFPs:
 - Multimode (model number: SFP-OC3-SR)
 - Intermediate reach (IR-1) (model number: SFP-OC3-IR)
 - Long reach (LR-1) (model number: SFP-OC3-LR)
- Optical interface specifications—see “[SONET/SDH OC3/STM1 Optical Interface Specifications](#)” on page 46

LEDs

One tricolor Status LED per port:

- Off—Not enabled.
- Green—Online with no alarms or failures.
- Yellow—Online with alarms for remote failures.
- Red—Active with a local alarm; router has detected a failure.

Alarms, errors, and events

- SONET alarms:
 - Alarm indication signal—line (AIS-L)
 - Alarm indication signal—path (AIS-P)
 - Bit error rate—signal degrade (BERR-SD)
 - Bit error rate—signal fail (BERR-SF)
 - Loss of clock (LOC)
 - Loss of frame (LOF)
 - Loss of light (LOL)
 - Loss of pointer (LOP)
 - Loss of signal (LOS)
 - Payload label mismatch (PLM-P)
 - Remote defect indication—line (RDI-L)
 - Remote defect indication—path (RDI-P)
 - Remote error indication (REI)
 - Payload unequipped (unequipped STS at path level) (UNEQ-P)
 - Virtual container—alarm indication signal (VAIS)
 - Virtual container—loss of clock (VLOC)
 - Virtual container—loss of pointer (VLOP)
 - Virtual container—mismatch (VMIS)
 - Virtual container—remote defect indication (VRDI)
 - Virtual container—unequipped (VUNEQ)
- SDH alarms:
 - Administrative unit alarm indication signal (AU-AIS)
 - Bit error rate signal degrade (BERR-SD)
 - Bit error rate signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1, B2, B3
 - Higher order path—alarm indication signal (HP-AIS)
 - Higher order path—far-end receiver error (HP-FERF)
 - Higher order path—payload label mismatch (HP-PLM)
 - Higher order path—loss of pointer (HP-LOP)
 - Higher order path—remote defect indication (HP-RDI)
 - Higher order path—unequipped (HP-UNEQ)
 - Loss of clock (LOC)
 - Loss of frame (LOF)
 - Loss of light (LOL)
 - Loss of signal (LOS)
 - Multiplex section—alarm indication signal (MS-AIS)
 - Multiplex section—far-end receive error (MS-FERF)
 - Multiplex section—remote defect indication (MS-RDI)
 - Multiplex section—remote error indication (MS-REI)

- Phase lock loop (PLL)
- Remote error indication (REI)
- Severely errored frame (SEF)
- Tributary unit—alarm indication signal (TU-AIS)
- Tributary unit—loss of clock (TU-LOC)
- Tributary unit—loss of pointer (TU-LOP)
- Tributary unit—mismatch (TU-MIS)
- Tributary unit—remote defect indication (TU-RDI)
- Tributary unit—unequipped (TU-UNEQ)
- DS1 alarms:
 - Alarm indication signal (AIS)
 - Loss of frame (LOF)
 - Remote alarm indication signal (RAIS)
- DS1 error detection:
 - Bursty errored seconds (BES)
 - CRC errors
 - Errored seconds (ES)
 - Line errored seconds (LES)
 - Loss of framing seconds (LOFS)
 - Loss of signal seconds (LOS)
 - Severely errored seconds (SES)
 - Severely errored framing seconds (SEFS)
 - Unavailable seconds (UAS)
- DS3 alarms:
 - Alarm indication signal (AIS)
 - Loss of frame (LOF)
 - Loss of signal (LOS)
 - Phase lock loop (PLL)
- DS3 error detection:
 - C-bit code violations (CCV)
 - C-bit errored seconds (CES)
 - C-bit severely errored framing seconds (CEFS)
 - CRC errors
 - Excessive zeros (EXZ)
 - Far-end block error (FEBE)
 - Far-end receive failure (FERF)
 - Line errored seconds (LES)
 - Parity bit (P-bit) code violations (PCV)
 - Parity bit (P-bit) errored seconds (PES)
 - Parity bit (P-bit) severely errored framing seconds (PSES)
 - Severely errored framing seconds (SEFS)
 - Unavailable seconds (UAS)

- Related Documentation**
- *T640 PIC Description*
 - *T640 PIC Combination Limitations*
 - [T640 PICs Supported on page 3](#)

Channelized OC12/STM4 Enhanced IQ (IQE) PICs with SFP (T640 Router)

Figure 3: 1-Port IQE PIC

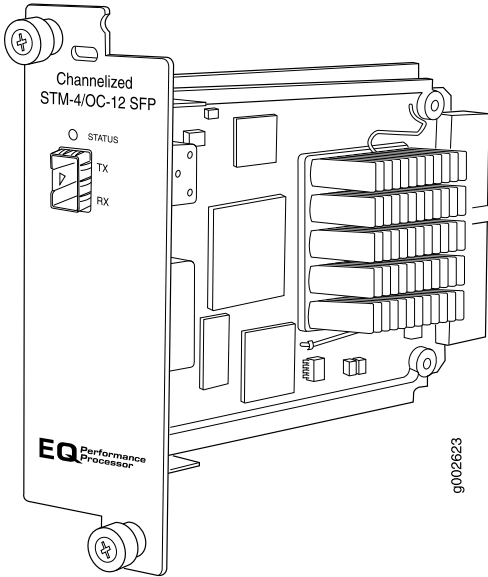


Figure 4: 4-Port IQE PIC (Type 2)

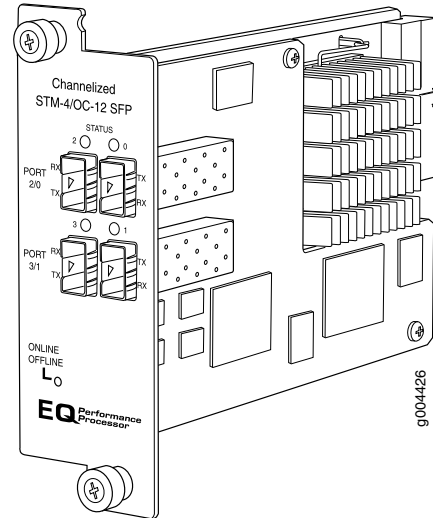
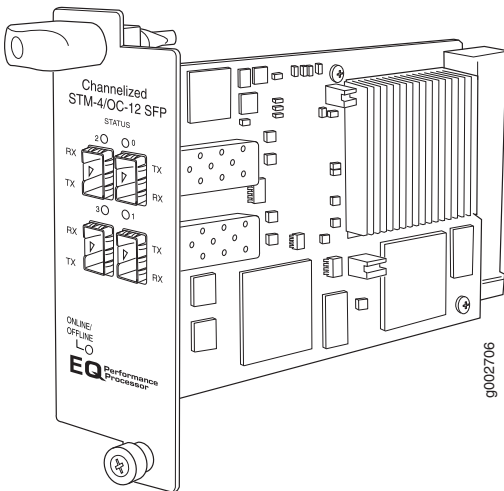


Figure 5: 4-Port IQE PIC (Type 3)



Software release

- 1-port: Junos OS Release 9.3 and later (Type 1)
- 4-port: Junos OS Release 9.4 and later (Type 2)
- 4-port: Junos OS Release 10.0R2 and later (Type 3)

For information on which FPCs support these PICs, see [“T640 PIC/FPC Compatibility” on page 12](#).

Description

- One or four OC12/STM4 ports

- SONET or SDH is configurable on a per-port granularity
- SONET channelization (1-port PIC):
 - 1 OC12 channel
 - 4 OC3 channels
 - 12 DS3 channels
 - 336 DS1 channels
 - 1011 DS0 channels
- SDH channelization (1-port PIC):
 - 1 STM4 channel
 - 4 STM1 channels
 - 12 E3 channels
 - 252 E1 channels
 - 12 DS3 channels (Junos OS Release 10.1 and later)
 - 336 DS1 channels (Junos OS Release 10.1 and later)
 - 1011 DS0 channels
- SONET channelization (4-port PIC):
 - 4 OC12 channel
 - 16 OC3 channels
 - 48 DS3 channels
 - 672 DS1 channels
 - 974 DS0 channels
- SDH channelization (4-port PIC):
 - 4 STM4 channel
 - 16 STM1 channels
 - 48 E3 channels
 - 504 E1 channels
 - 48 DS3 channels (Junos OS Release 10.1 and later)
 - 672 DS1 channels (Junos OS Release 10.1 and later)
 - 974 DS0 channels
- Power requirement:
 - 1-port: 0.64 A @ -48 V (30.7 W)
 - 4-port: 1.08 A @ -48V (52 W)
- Model number for 1-Port IQE PIC: PB-1CHOC12-STM4-IQE-SFP
Model number for 4-Port IQE PIC: PB-4CHOC12-STM4-IQE-SFP

Hardware features	• 1-port: Port is numbered 0. • 4-port: Ports are numbered: • Top row: 2 and 0 from left to right • Bottom row: 3 and 1 from left to right
Software features	• Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) • Enhanced fine-grained queuing per logical interface. See the <i>Class of Service Feature Guide for Routing Devices</i> for more information about class of service features. • Subrate and scrambling: • Digital Link/Quick Eagle • Kentrox

- Larscom
- ADTRAN
- Verilink
- Packet buffering, Layer 2 parsing
- M13/C-bit parity encoding
- DS3 far-end alarm and control (FEAC) channel support
- Local line, remote line, and remote payload loopback testing
- Simple Network Management Protocol (SNMP): OC3 MIB, DS3 MIB, T1 MIB
- Dynamic, arbitrary channel configuration
- Full bit error rate test (BERT)
- Encapsulations:
 - Circuit cross-connect (CCC)
 - Translational cross-connect (TCC)
 - Extended Frame Relay for CCC and TCC
 - Flexible Frame Relay
 - Frame Relay
 - Frame Relay for CCC
 - Frame Relay for TCC
 - Frame Relay port CCC
 - High-Level Data Link Control (HDLC)
 - HDLC framing for CCC
 - HDLC framing for TCC
 - MPLS CCC
 - MPLS TCC
 - Multilink Frame Relay (MLFR) UNI NNI (MFR FRF.16)
 - Point-to-Point Protocol (PPP)
 - PPP for CCC
 - PPP for TCC
- Encapsulations available only for DS1:
 - Multilink Frame Relay end-to-end (MLFR FRF.15)
 - Multilink PPP (MLPPP)
 - PPP over Frame Relay

Cables and connectors

- Duplex LC/PC connector (Rx and Tx); single-mode fiber
- SONET/SDH OC12/STM4 fiber-optic SFP transceivers:
 - Short reach (model number: SFP-OC12-SR)
 - Intermediate reach (IR-1) (model number: SFP-OC12-IR)
 - Long reach (LR-1) (model number: SFP-OC12-LR)

Optical interface specifications—see [“SONET/SDH OC12/STM4 Optical Interface Specifications” on page 48](#)

LEDs

One tricolor per port:

- Off—Not enabled
- Green—Online with no alarms or failures
- Yellow—Online with alarms for remote failures
- Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events

- SONET alarms:
 - Alarm indication signal—line (AIS-L)
 - Alarm indication signal—path (AIS-P)
 - Bit error rate—signal degrade (BERR-SD)
 - Bit error rate—signal fail (BERR-SF)
 - Loss of frame (LOF)
 - Loss of light (LOL)
 - Loss of pointer (LOP)
 - Loss of signal (LOS)
 - Payload label mismatch (PLM-P)
 - Remote defect indication—line (RDI-L)
 - Remote defect indication—path (RDI-P)
 - Remote error indication (REI)
 - Payload unequipped (unequipped STS at path level) (UNEQ-P)
 - Virtual container—alarm indication signal (VAIS)
 - Virtual container—loss of pointer (VLOP)
 - Virtual container—mismatch (VMIS)
 - Virtual container—remote defect indication (VRDI)
 - Virtual container—unequipped (VUNEQ)
- SDH alarms:
 - Administrative unit alarm indication signal (AU-AIS)
 - Bit error rate—signal degrade (BERR-SD)
 - Bit error rate—signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1, B2, B3
 - Higher order path—alarm indication signal (HP-AIS)
 - Higher order path—far-end receive failure (HP-FERF)
 - Higher order path—payload label mismatch (HP-PLM)
 - Higher order path—loss of pointer (HP-LOP)
 - Higher order path—remote defect indication (HP-RDI)
 - Higher order path—unequipped (HP-UNEQ)
 - Loss of frame (LOF)
 - Loss of light (LOL)
 - Loss of signal (LOS)
 - Multiplex section—alarm indication signal (MS-AIS)
 - Multiplex section—far-end receive failure (MS-FERF)
 - Multiplex section—remote defect indication (MS-RDI)
 - Multiplex section—remote error indication (MS-REI)
 - Phase lock loop (PLL)
 - Remote error indication (REI)
 - Severely errored frame (SEF)

- Tributary unit—alarm indication signal (TU-AIS)
- Tributary unit—loss of pointer (TU-LOP)
- Tributary unit—mismatch (TU-MIS)
- Tributary unit—remote defect indication (TU-RD1)
- Tributary unit—unequipped (TU-UNEQ)
- DS1 alarms:
 - Alarm indication signal (AIS)
 - Loss of frame (LOF)
 - Remote alarm indication signal (RAIS)
- DS1 error detection:
 - Bursty errored seconds (BES)
 - CRC errors
 - Errored seconds (ES)
 - Line errored seconds (LES)
 - Loss of framing seconds (LOFS)
 - Severely errored seconds (SES)
 - Severely errored framing seconds (SEFS)
 - Unavailable seconds (UAS)
- DS3 alarms:
 - Alarm indication signal (AIS)
 - Loss of frame (LOF)
 - Yellow alarm
- DS3 error detection:
 - C-bit code violations (CCV)
 - C-bit errored seconds (CES)
 - C-bit severely errored framing seconds (CEFS)
 - CRC errors
 - Excessive zeros (EXZ)
 - Far-end block error (FEBE)
 - Far-end receive failure (FERF)
 - Line errored seconds (LES)
 - Parity bit (P-bit) code violations (PCV)
 - Parity bit (P-bit) errored seconds (PES)
 - Parity bit (P-bit) severely errored framing seconds (PSES)
 - Severely errored framing seconds (SEFS)
 - Unavailable seconds (UAS)

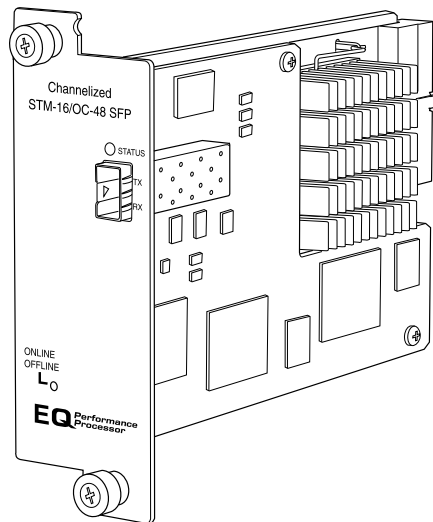
Instrumentation
(counters)

- Layer 2 per-queue and per-channel packet and byte counters

Related Documentation

- *T640 PIC Description*
- *T640 PIC Combination Limitations*
- [T640 PICs Supported on page 3](#)

Channelized OC48/STM16 Enhanced IQ (IQE) PIC with SFP (T640 Router)



Software release	Junos OS Release 9.4 and later (Type 2) For information on which FPCs support this PIC, see "T640 PIC/FPC Compatibility" on page 12.
Description	- One OC48/STM16 port - SONET or SDH is configurable on a per-port granularity - SONET channelization: 4 OC12 channels 16 OC3 channels 48 DS3 channels 672 DS1 channels 975 DS0 channels - SDH channelization: 4 STM4 channels 16 STM1 channels 48 E3 channels 504 E1 channels 48 DS3 channels 672 DS1 channels 975 DS0 channels - Power requirement: 1.10 A @ 48V (53 W) - Model number: PB-1CHOC48-STM16-IQE-SFP
Hardware features	Port is numbered 0.

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

- Cables and connectors
- Duplex LC connector (Rx and Tx); single-mode fiber
 - SONET/SDH OC48/STM16 fiber-optic SFP transceivers:
 - Short reach (SR-1) (model number: SFP-1OC48-SR)
 - Intermediate reach (IR-1) (model number: SFP-1OC48-IR)
 - Long reach (LR-1) (model number: SFP-1OC48-LR)
- Optical interface specifications—see [“SONET/SDH OC48/STM16 Optical Interface Specifications” on page 51](#)

LEDs

One tricolor per port:

- Off—Not enabled
- Green—Online with no alarms or failures
- Yellow—Online with alarms for remote failures
- Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events

- SONET alarms:
 - Alarm indication signal—line (AIS-L)
 - Alarm indication signal—path (AIS-P)
 - Bit error rate—signal degrade (BERR-SD)
 - Bit error rate—signal fail (BERR-SF)
 - Loss of frame (LOF)
 - Loss of light (LOL)
 - Loss of pointer (LOP)
 - Loss of signal (LOS)
 - Payload label mismatch (PLM-P)
 - Remote defect indication—line (RDI-L)
 - Remote defect indication—path (RDI-P)
 - Remote error indication (REI)
 - Payload unequipped (unequipped STS at path level) (UNEQ-P)
 - Virtual container—alarm indication signal (VAIS)
 - Virtual container—loss of pointer (VLOP)
 - Virtual container—mismatch (VMIS)
 - Virtual container—remote defect indication (VRDI)
 - Virtual container—unequipped (VUNEQ)
- SDH alarms:
 - Administrative unit alarm indication signal (AU-AIS)
 - Bit error rate—signal degrade (BERR-SD)
 - Bit error rate—signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1, B2, B3
 - Higher order path—alarm indication signal (HP-AIS)
 - Higher order path—far-end receive failure (HP-FERF)
 - Higher order path—payload label mismatch (HP-PLM)
 - Higher order path—loss of pointer (HP-LOP)
 - Higher order path—remote defect indication (HP-RDI)
 - Higher order path—unequipped (HP-UNEQ)
 - Loss of frame (LOF)
 - Loss of light (LOL)
 - Loss of signal (LOS)
 - Multiplex section—alarm indication signal (MS-AIS)
 - Multiplex section—far-end receive failure (MS-FERF)
 - Multiplex section—remote defect indication (MS-RDI)
 - Multiplex section—remote error indication (MS-REI)
 - Phase lock loop (PLL)
 - Remote error indication (REI)
 - Severely errored frame (SEF)
 - Tributary unit—alarm indication signal (TU-AIS)

- Tributary unit—loss of pointer (TU-LOP)
- Tributary unit—mismatch (TU-MIS)
- Tributary unit—remote defect indication (TU-RD1)
- Tributary unit—unequipped (TU-UNEQ)
- DS1 alarms:
 - Alarm indication signal (AIS)
 - Loss of frame (LOF)
 - Remote alarm indication signal (RAIS)
- DS1 error detection:
 - Bursty errored seconds (BES)
 - CRC errors
 - Errored seconds (ES)
 - Line errored seconds (LES)
 - Loss of framing seconds (LOFS)
 - Severely errored seconds (SES)
 - Severely errored framing seconds (SEFS)
 - Unavailable seconds (UAS)
- DS3 alarms:
 - Alarm indication signal (AIS)
 - Loss of frame (LOF)
 - Yellow alarm
- DS3 error detection:
 - C-bit code violations (CCV)
 - C-bit errored seconds (CES)
 - C-bit severely errored framing seconds (CEFS)
 - CRC errors
 - Excessive zeros (EXZ)
 - Far-end block error (FEBE)
 - Far-end receive failure (FERF)
 - Line errored seconds (LES)
 - Parity bit (P-bit) code violations (PCV)
 - Parity bit (P-bit) errored seconds (PES)
 - Parity bit (P-bit) severely errored framing seconds (PSES)
 - Severely errored framing seconds (SEFS)
 - Unavailable seconds (UAS)

Instrumentation
(counters)

- Layer 2 per-queue and per-channel packet and byte counters

Table 50: PICs Supported in Fourth Slot of T640-FPC2-E and T640-FPC2-E2 with Type 2 IQE PICs

PIC Name	PIC Model Number
Gigabit Ethernet, 2-port SFP	PB-2GE-SFP
Gigabit Ethernet, 4-port SFP	PB-4GE-SFP
Gigabit Ethernet IQ, 2-port SFP	PB-2GE-SFP-QPP
SONET/SDH OC12c/STM4, 4-port with multimode transceivers installed	PB-4OC12-SON-MM
SONET/SDH OC12c/STM4, 4-port with single-mode intermediate reach transceivers installed	PB-4OC12-SON-SMIR
SONET/SDH OC48/STM16, 1-port SFP	PB-1OC48-SON-SFP
Tunnel Services	PB-TUNNEL

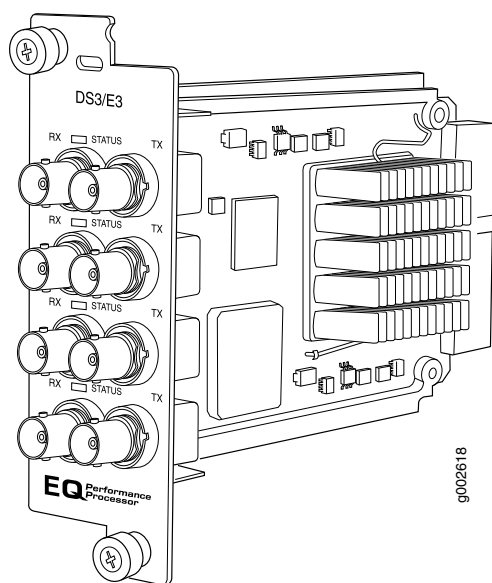
- Related Documentation**
- *T640 PIC Description*
 - *T640 PIC Combination Limitations*
 - [T640 PICs Supported on page 3](#)

CHAPTER 6

DS3 and E3 PIC Descriptions

- DS3/E3 Enhanced IQ (IQE) PIC (T640 Router) on page 101
- E3 IQ PIC (T640 Router) on page 104

DS3/E3 Enhanced IQ (IQE) PIC (T640 Router)



Software release	• Junos OS Release 9.3 and later For information on which FPCs support this PIC, see "T640 PIC/FPC Compatibility" on page 12.
Description	• Four DS3 or E3 ports • DS3 or E3 is configurable on a per-port granularity • Power requirement: 0.51 A @ 48 V (24.7 W) • Model number: PB-4DS3-E3-IQE-BNC
Hardware features	• Ports are numbered 0 through 3 top to bottom
Software features	• Maximum transmission units (MTUs) of up to 9192 bytes • Subrate and scrambling: NOTE: Only DS3 interfaces support subrate and scrambling.

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

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

- Data service unit (DSU) functionality
- B3ZS line encoding
- Framing: M13, C-bit parity, framed clear channel
- Full bit error rate test (BERT)
- ANSI T1.403 FDL
- Internal and loop clocking
- DS3 far end alarm and control (FEAC) channel
- Local line, remote line, and remote playback loopback testing
- Simple Network Management Protocol (SNMP): DS3 MIB
- Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)
- Enhanced fine-grained queuing per logical interface. See the *Class of Service Feature Guide for Routing Devices* for more information about class of service features.
- Encapsulations:
 - Circuit cross-connect (CCC)
 - Translational cross-connect (TCC)
 - Extended Frame Relay for CCC and TCC
 - Flexible Frame Relay
 - Frame Relay
 - Frame Relay for CCC
 - Frame Relay for TCC
 - Frame Relay port CCC
 - High-Level Data Link Control (HDLC)
 - HDLC framing for CCC
 - HDLC framing for TCC
 - MPLS CCC
 - MPLS TCC
 - Multilink Frame Relay (MLFR) UNI NNI (MFR FRF.16)
 - Point-to-Point Protocol (PPP)
 - PPP for CCC
 - PPP for TCC

Cables and connectors	• Standard DS3 BNC coaxial cable interfaces
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LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure
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Alarms, errors, and events

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

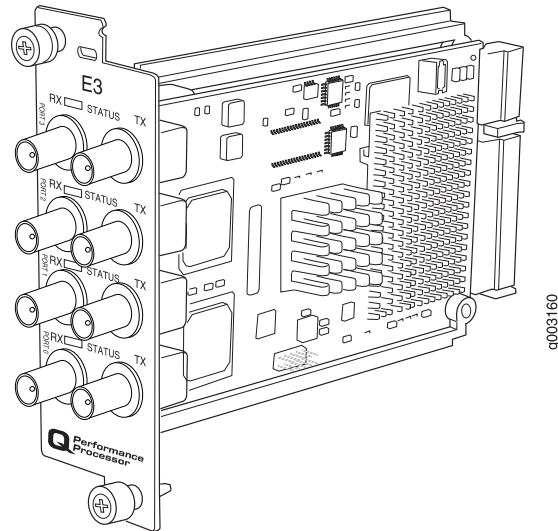
Instrumentation (counters)

- Layer 2 per-queue and per-channel packet and byte counters

Related Documentation

- *T640 PIC Description*
- *T640 PIC Combination Limitations*
- [T640 PICs Supported on page 3](#)

E3 IQ PIC (T640 Router)



Software release

- Junos OS Release 6.3 and later (Type 1)
- Junos OS Release 7.3 and later in T640 routers connected to a TX Matrix router

For information on which FPCs support these PICs, see [“T640 PIC/FPC Compatibility” on page 12](#).

Description

- Four E3 ports
- Power requirement: 0.38 A @ 48 V (18 W)
- Fine-grained queuing per logical interface
- Model number: PB-4E3-QPP

Hardware features

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

Software features	• Quality of service (QoS) per port: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) • Simple Network Management Protocol (SNMP): E3 MIB, QoS MIB • Input policing and output shaping • Provider-side rate limiting • Full data link connection identifier (DLCI) range with sparse channel numbering • Per-DLCI queues with weighted deficit round-robin and strict priority • Encapsulations: • High-Level Data Link Control (HDLC) • Frame Relay • Circuit cross-connect (CCC) • Translational cross-connect (TCC) • Point-to-Point Protocol (PPP) • Junos OS Release 7.0 or later is recommended to configure graceful Routing Engine switchover (GRES).
Cables and connectors	• Standard E3 BNC coaxial cable interfaces
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure
Alarms, errors, and events	• Alarm indication signal (AIS) • Equipment failure (does not affect service) • Frame error • Line code violation • Loss of signal (LOS) • Out of frame (OOF) • Yellow alarm bit (A-bit) disagreements
Instrumentation (counters)	• Layer 2 per-queue packet and byte counters

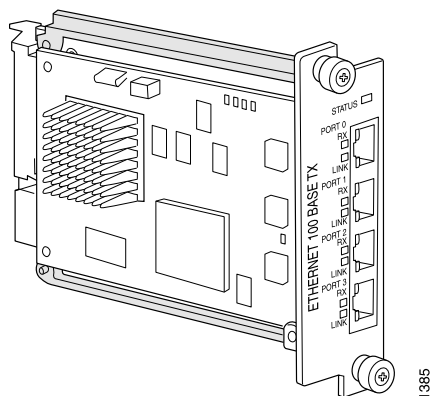
- Related Documentation**
- *T640 PIC Description*
 - *T640 PIC Combination Limitations*
 - [T640 PICs Supported on page 3](#)

CHAPTER 7

Fast Ethernet and Gigabit Ethernet PIC Descriptions

- Fast Ethernet PIC (T640 Router) on page 107
- Gigabit Ethernet PICs with SFP (T640 Router) on page 109

Fast Ethernet PIC (T640 Router)



Software release	• Junos OS Release 6.3 and later (Type 1) For information on which FPCs support this PIC, see “T640 PIC/FPC Compatibility” on page 12.
Description	• 4 100Base-TX ports • Power requirement: 0.14 A @ 48 V (6.8 W) • Model number: PB-4FE-TX
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 • MTUs up to 1533 bytes • 1,024 autosensing 802.1q VLANs per port

- | | |
|-------------------|--|
| Software features | <ul style="list-style-type: none">• 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 | <ul style="list-style-type: none">• Connector: Two-pair, Category 5 unshielded twisted-pair connectivity through an RJ-45 connector• Pinout: MDI noncrossover |
|-----------------------|--|

- | | |
|------|--|
| LEDs | <p>Status LED, one bicolor:</p> <ul style="list-style-type: none">• Off—PIC ports not enabled.• Green—PIC is operating normally.• Red—PIC has an error or failure. <p>4-port PIC—One pair of port LEDs:</p> <ul style="list-style-type: none">• 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. |
|------|--|

-
- | | |
|------------------------------|---|
| Related Documentation | <ul style="list-style-type: none">• <i>T640 PIC Description</i>• <i>T640 PIC Combination Limitations</i>• T640 PICs Supported on page 3 |
|------------------------------|---|

Gigabit Ethernet PICs with SFP (T640 Router)

Figure 6: 1-Port Gigabit Ethernet PIC

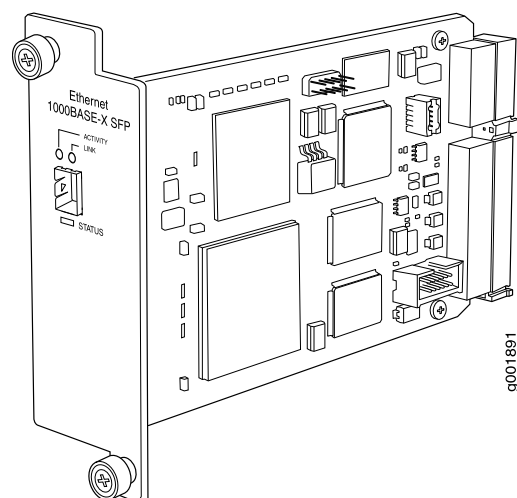


Figure 7: 2-Port Gigabit Ethernet PIC

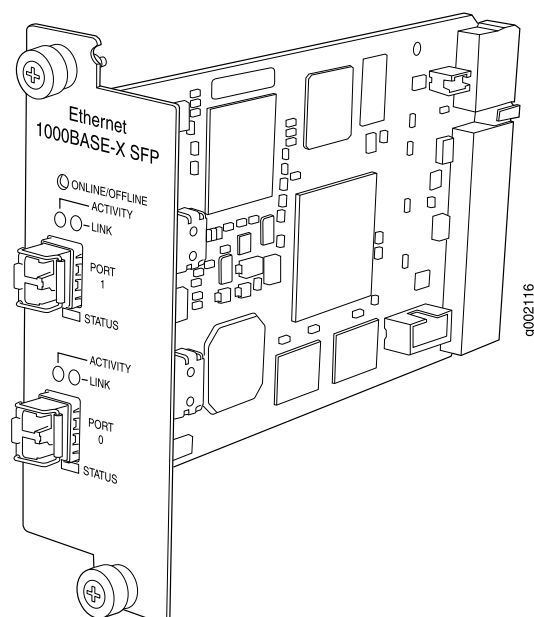


Figure 8: 4-Port Gigabit Ethernet PIC

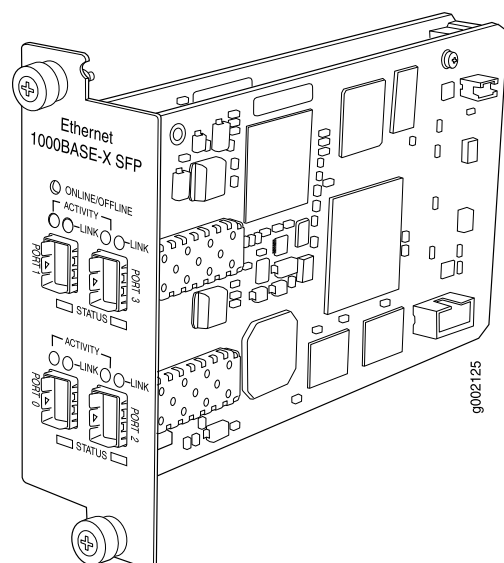
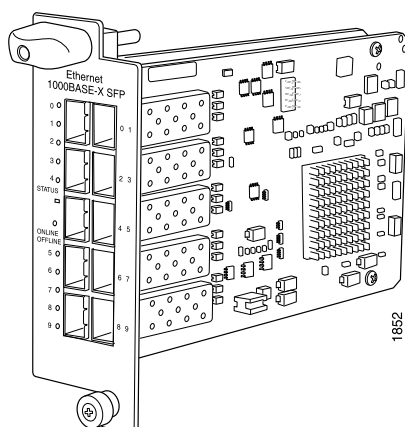


Figure 9: 10-Port Gigabit Ethernet PIC



Software release	1-port: Junos OS Release 8.0 and later (Type 1) 2-port: Junos OS Release 6.4 and later (Type 2) 4-port: Junos OS Release 7.0 and later (Type 2) 10-port: Junos OS Release 5.5 and later (Type 3) For information on which FPCs support these PICs, see "T640 PIC/FPC Compatibility" on page 12.
Description	- One, two, four, or ten Gigabit Ethernet ports - Power requirement: 1-port: 0.25 A @ 48 V (11.9 W) 2-port: 0.25 A @ 48 V (11.9 W) 4-port: 0.50 A @ 48 V (23.8 W) 10-port: 0.62 A @ 48 V (29.9 W) - Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network - Model number for 1-Port Gigabit Ethernet PIC: PB-1GE-SFP - Model number for 2-Port Gigabit Ethernet PIC: PB-2GE-SFP - Model number for 4-Port Gigabit Ethernet PIC: PB-4GE-SFP - Model number for 10-Port Gigabit Ethernet PIC: PB-10GE-SFP
Hardware features	- High-performance throughput on each port at speeds up to 1 Gbps - Autonegotiation between Gigabit Ethernet circuit partners - Full-duplex mode - Maximum transmission units (MTUs) of up to 9192 bytes
Software features	- Virtual Router Redundancy Protocol (VRRP) support 802.1q virtual LANs (VLANs) support 960 destination MAC filters per port - Optical diagnostics and related alarms on the 2-port, 4-port, and 10-port PICs (Junos OS Release 8.2 and later) 64 source MAC filters per VLAN on the 1-port, 2-port, and 4-port PICs 1024 source MAC filters per port on the 1-port, 2-port, and 4-port PICs - Flexible Ethernet encapsulation on the 1-port, 2-port, and 4-port PICs - Multiple tag protocol identifiers (TPID) support on the 1-port, 2-port, and 4-port PICs - Source MAC learning on the 1-port, 2-port, and 4-port PICs - MAC accounting and policing—Dynamic local address learning of source MAC addresses on the 1-port, 2-port, and 4-port PICs - Passive monitoring for IPv4 packets on the 10-port PIC for Junos OS Release 11.1 and later. NOTE: The 10-port Gigabit Ethernet PIC with SFP does not support MAC accounting and policing, MAC learning, TPID, or flexible Ethernet encapsulation. 64 source MAC filters per port.

Cables and connectors	- You can install any transceiver supported by the PIC. - Fiber-optic SFP transceivers: - Duplex LC/PC connector (Rx and Tx) 1000Base-LH (model number: SFP-1GE-LH) 1000Base-LX (model number: SFP-1GE-LX) 1000Base-SX (model number: SFP-1GE-SX) - Optical interface specifications—see “Gigabit Ethernet 1000BASE Optical Interface Specifications” on page 32 1000Base-BX (model number pairs: SFP-GE10KT13R14 with SFP-GE10KT14R13, SFP-GE10KT13R15 with SFP-GE10KT15R13, SFP-GE40KT13R15 with SFP-GE40KT15R13)—see “Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications” on page 28 - Copper transceivers: - Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector 1000Base-T (model number: SFP-1GE-T) - Copper interface specifications—see “Gigabit Ethernet 1000BASE-T Copper Interface Specifications” on page 35 NOTE: Do not install Gigabit Ethernet SFPs in the SONET/SDH port. The port will not recognize the SFP.
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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.
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Related Documentation	<i>T640 PIC Description</i> <i>T640 PIC Combination Limitations</i> T640 PICs Supported on page 3
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Ethernet IQ PIC Descriptions

- Gigabit Ethernet IQ PICs with SFP (T640 Router) on page 113

Gigabit Ethernet IQ PICs with SFP (T640 Router)

Figure 10: 1-Port Gigabit Ethernet IQ PIC

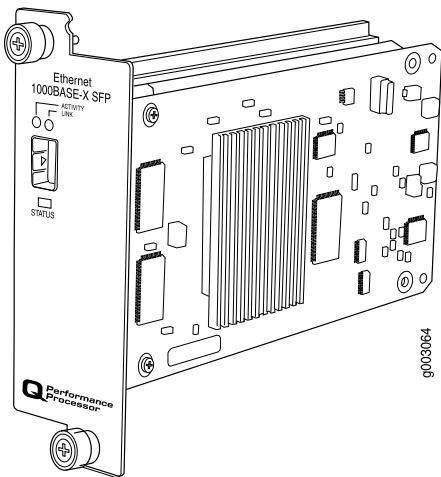
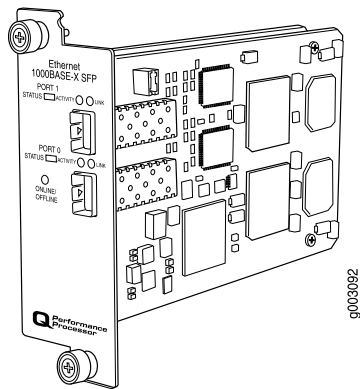


Figure 11: 2-Port Gigabit Ethernet IQ PIC



Software release	• 1-port: Junos OS Release 8.0 and later (Type 1) • 2-port (Type 2): • Junos OS Release 6.1 and later • Junos OS Release 7.3 and later in T640 routers connected to a TX Matrix router For information on which FPCs support these PICs, see “T640 PIC/FPC Compatibility” on page 12.
Description	• One or two Gigabit Ethernet ports • Power requirement: 0.46 A @ 48 V (22 W) • Fine-grained queuing per logical interface • Model number for 1-Port Gigabit Ethernet IQ PIC: PB-IGE-SFP-QPP • Model number for 2-Port Gigabit Ethernet IQ PIC: PB-2GE-SFP-QPP

Hardware features	• High-performance throughput on each port at speeds up to 1 Gbps • Full-duplex mode • Large MTUs of up to 9192 bytes
Software features	• Optical diagnostics and related alarms (Junos OS Release 8.2 and later) • Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) • Virtual Router Redundancy Protocol (VRRP) support • 802.1q virtual LANs (VLANs) • VLAN stacking and rewriting • Flexible Ethernet encapsulation • MAC policing, accounts, and filters • Junos OS Release 7.0 or later is recommended to configure graceful Routing Engine switchover (GRES).
Cables and connectors	• You can install any transceiver supported by the PIC. • SFP transceivers: • Duplex LC/PC connector (Rx and Tx) • Fiber-optic transceivers: • 1000Base-LH (model number: SFP-1GE-LH) • 1000Base-LX (model number: SFP-1GE-LX) • 1000Base-SX (model number: SFP-1GE-SX) • Optical interface specifications—see “Gigabit Ethernet 1000BASE Optical Interface Specifications” on page 32 • 1000Base-BX (model number pairs: SFP-GE10KT13R14 with SFP-GE10KT14R13, SFP-GE10KT13R15 with SFP-GE10KT15R13, SFP-GE40KT13R15 with SFP-GE40KT15R13)—see “Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications” on page 28 • Copper transceivers: • Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector • 1000Base-T (model number: SFP-1GE-T) • Copper interface specifications—see “Gigabit Ethernet 1000BASE-T Copper Interface Specifications” on page 35 NOTE: Do not install SONET/SDH OC48c/STM16 SFPs in the Gigabit Ethernet port. The port will not recognize the SFP.
LEDs	Status LED, one tricolor: • Off—Not enabled. • Green—Online with no alarms or failures. • Yellow—Online with alarms for remote failures. • Red—Active with a local alarm; router has detected a failure. NOTE: The green status LED is lit on the 2-port Gigabit Ethernet IQ PIC when at least one port is online. Port LEDs, one per port: • Off—Port is down. • Green—Link is established.

- Related Documentation**
- *T640 PIC Description*
 - *T640 PIC Combination Limitations*
 - [T640 PICs Supported on page 3](#)

CHAPTER 9

Ethernet IQ2 PIC Descriptions

- Gigabit Ethernet IQ2 PICs with SFP (T640 Router) on page 117
- 10-Gigabit Ethernet IQ2 PIC with XFP (T640 Router) on page 120

Gigabit Ethernet IQ2 PICs with SFP (T640 Router)

Figure 12: 4-Port Gigabit Ethernet IQ2 PIC (Type 1)

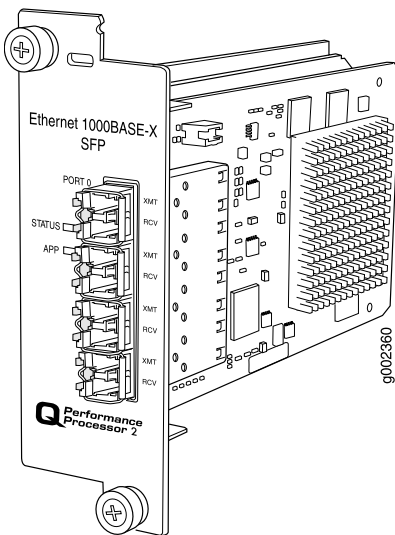


Figure 13: 8-Port Gigabit Ethernet IQ2 PIC (Type 2)

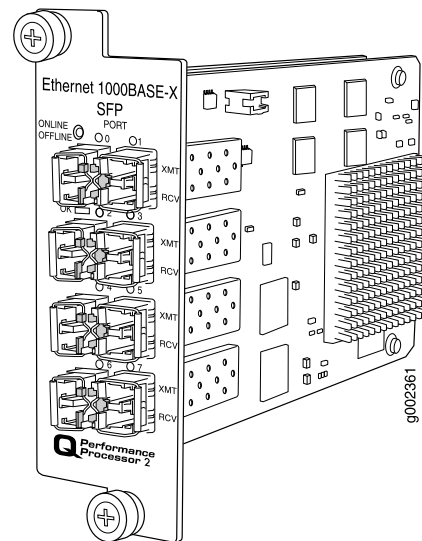
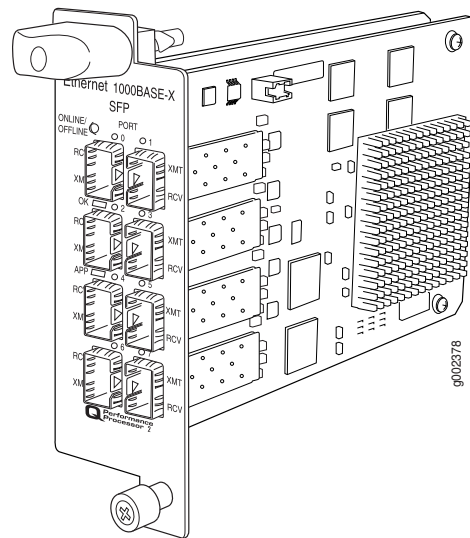


Figure 14: 8-Port Gigabit Ethernet IQ2 PIC (Type 3)



Software release

- 4-port: Junos OS Release 7.6R3 and later (Type 1)
- 8-port: Junos OS Release 7.6R2 and later (Type 2)
- 8-port: Junos OS Release 8.2 and later (Type 3)

For information on which FPCs support these PICs, see [“T640 PIC/FPC Compatibility” on page 12](#).

Description

- Four or eight Gigabit Ethernet ports
- Power requirement:
 - 4-port: 0.65 A @ 48 V (31 W)
 - 8-port (Type 2): 0.89 A @ 48 V (42.5 W)
 - 8-port (Type 3): 1.25 A @ 48 V (60 W)
- Model number for 4-Port Gigabit Ethernet IQ2 PIC: PB-4GE-TYPE1-SFP-IQ2
 Model number for 8-Port Type 2 Gigabit Ethernet IQ2 PIC: PB-8GE-TYPE2-SFP-IQ2
 Model number for 8-Port Type 3 Gigabit PIC: PB-8GE-TYPE3-SFP-IQ2

Hardware features

- High-performance throughput up to 1 Gbps on each port
- Full-duplex mode
- Large maximum transmission units (MTUs) of up to 9192 bytes

- Software features
- Intelligent handling of oversubscribed traffic for Type 1 and Type 2 PICs
 - Optical diagnostics and related alarms (Junos OS Release 8.2 and later)
 - Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)
 - Virtual Router Redundancy Protocol (VRRP) support
 - Hierarchical shaping
 - Fine-grained queuing and shaping per logical interface at both ingress and egress
 - 802.1q virtual LANs (VLANs)
 - VLAN stacking and rewriting
 - Channels defined by two stacked VLAN tags
 - Multiple tag protocol identifiers (TPID) support
 - IP service for nonstandard TPID and stacked VLAN tags
 - 802.1p rewrite per channel
 - Flexible mapping of channels and scheduler resources at both ingress and egress
 - Flexible Ethernet encapsulation
 - MAC learning, policing, accounting, and filtering

- Cables and connectors
- You can install any transceiver supported by the PIC.
 NOTE: Do not install SONET/SDH SFPs in the Gigabit Ethernet port. The port will not recognize the SFP.
 - Fiber-optic small form-factor pluggable (SFP) transceivers:
 - Duplex LC/PC connector (Rx and Tx)
 - 1000Base-LH (model number: SFP-1GE-LH)
 - 1000Base-LX (model number: SFP-1GE-LX)
 - 1000Base-SX (model number: SFP-1GE-SX)
 - Optical interface specifications—see [“Gigabit Ethernet 1000BASE Optical Interface Specifications” on page 32](#)
 - 1000Base-BX (model number pairs: SFP-GE10KT13R14 with SFP-GE10KT14R13, SFP-GE10KT13R15 with SFP-GE10KT15R13, SFP-GE40KT13R15 with SFP-GE40KT15R13)—see [“Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications” on page 28](#)
 - Copper transceivers:
 - Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
 - 1000Base-T (model number: SFP-1GE-T)
 - Copper interface specifications—see [“Gigabit Ethernet 1000BASE-T Copper Interface Specifications” on page 35](#)

LEDs

OK or Status LED, one tricolor:

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

APP LED, one bicolor:

- Off—Monitoring application is not running.
- Green—Monitoring application is running under acceptable load.

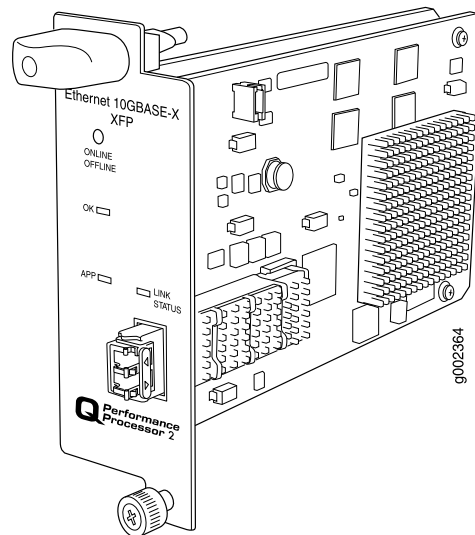
Port LEDs, one per port:

- Off—Port is not enabled.
- Green—Port is online with no alarms or failures.

Related Documentation

- [T640 PIC Description](#)
- [T640 PIC Combination Limitations](#)
- [T640 PICs Supported on page 3](#)

10-Gigabit Ethernet IQ2 PIC with XFP (T640 Router)



Software release

- Junos OS Release 8.0R3 and later (Type 3)
For information on which FPCs support this PIC, see "[T640 PIC/FPC Compatibility](#)" on page 12.

Description

- One 10-Gigabit Ethernet port
- Power requirements: 1.2 A @48 V (56 W)
- Model number: PC-1XGE-TYPE3-XFP-IQ2E

Hardware features	• High-performance throughput • WAN-PHY mode at 9.953 Gbps • LAN-PHY mode at 10.3125 Gbps • Full-duplex mode • Large maximum transmission units (MTUs) of up to 9192 bytes
Software features	• Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) • Configurable WAN-PHY mode options: • loopback • mpls • path-trace • trigger • Virtual Router Redundancy Protocol (VRRP) support • Hierarchical shaping • Fine-grained queueing and shaping per logical interface at both ingress and egress • 802.1q virtual LANs (VLANs) • VLAN stacking and rewriting • Channels defined by two stacked VLAN tags • Multiple tag protocol identifiers (TPID) support • IP service for nonstandard TPID and stacked VLAN tags • 802.1p rewrite per channel • Flexible mapping of channels and scheduler resources at both ingress and egress • Flexible Ethernet encapsulation • MAC learning, policing, accounting, and filtering
Cables and connectors	• You can install any transceiver supported by the PIC. • Fiber-optic 10-Gigabit small form-factor pluggable (XFP) transceivers: • Duplex LC/PC connector (Rx and Tx) • 10GBASE-S (model number: XFP-10G-S) • 10GBASE-L (model number: XFP-10G-L-OC192-SR1) • 10GBASE-E (model number: XFP-10G-E-OC192-IR2) • 10GBASE-Z (model number: XFP-10G-Z-OC192-LR2) • 10-Gigabit Ethernet XFP transceivers: Optical interface specifications—see “10-Gigabit Ethernet 10GBASE Optical Interface Specifications” on page 36

LEDs

OK LED, one tricolor:

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

APP LED, one:

- Off—Monitoring application is not running.
- Green—Monitoring application is running under acceptable load.
- Yellow—Monitoring application is overloaded.

Link Status LED, one:

- Off—Port is down.
 - Green—Port is online. Link is established.
-

**Related
Documentation**

- *T640 PIC Description*
- *T640 PIC Combination Limitations*
- [T640 PICs Supported on page 3](#)

CHAPTER 10

Ethernet Enhanced IQ2 (IQ2E) PIC Descriptions

- Gigabit Ethernet Enhanced IQ2 (IQ2E) PICs with SFP (T640 Router) on page 123
- 10-Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with XFP (T640 Router) on page 126

Gigabit Ethernet Enhanced IQ2 (IQ2E) PICs with SFP (T640 Router)

Figure 15: 4-Port Gigabit Ethernet IQ2E PIC (Type 1)

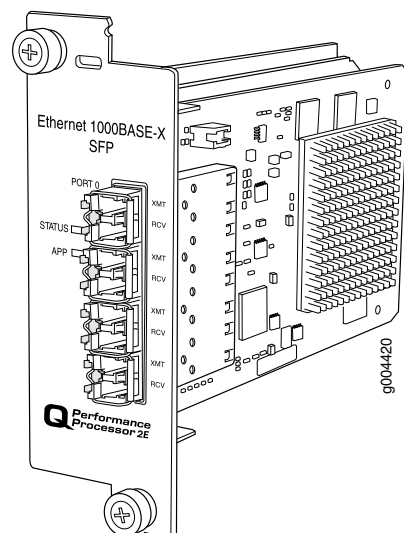


Figure 16: 8-Port Gigabit Ethernet IQ2E PIC (Type 2)

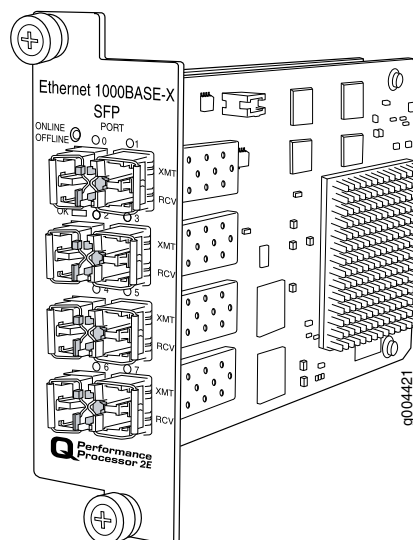
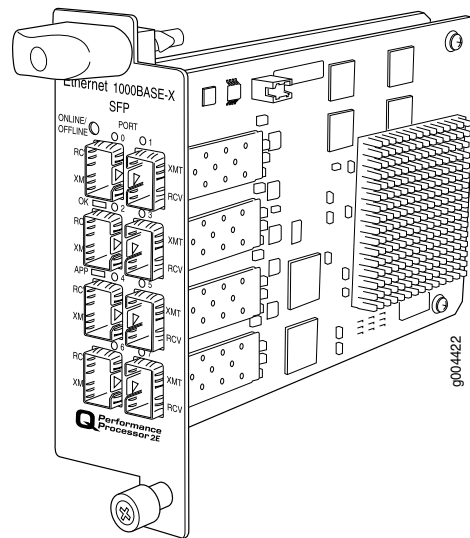


Figure 17: 8-Port Gigabit Ethernet IQ2E PIC (Type 3)



Software release

- 4-port: Junos OS Release 9.4 and later (Type 1)
- 8-port: Junos OS Release 9.4 and later (Type 2)
- 8-port: Junos OS Release 9.4 and later (Type 3)

For information on which FPCs support these PICs, see [“T640 PIC/FPC Compatibility” on page 12](#).

Description

- Four or eight Gigabit Ethernet ports
- Power requirement:
 - 4-port: 0.67 A @ 48 V (32 W)
 - 8-port (Type 2): 0.92 A @ 48 V (44 W)
 - 8-port (Type 3): 1.25 A @ 48 V (60 W)
- Model number for 4-Port Gigabit Ethernet IQ2E PIC: PB-4GE-TYPE1-SFP-IQ2E
 Model number for Type 2 8-Port Gigabit Ethernet IQ2E PIC: PB-4GE-TYPE2-SFP-IQ2E
 Model number for Type 3 8-Port Gigabit Ethernet IQ2E PIC: PB-4GE-TYPE3-SFP-IQ2E

Hardware features

- High-performance throughput on each port:
 - 4-port with SFP: speeds up to 1 Gbps
 - 8-port with SFP: speeds up to 4 Gbps (Type 2)
 - 8-port with SFP: speeds up to 8 Gbps (Type 3)
- Full-duplex mode
- Large maximum transmission units (MTUs) of up to 9192 bytes

- Software features
- Intelligent handling of oversubscribed traffic for Type 1 and Type 2 PICs
 - Optical diagnostics and related alarms (Junos OS Release 8.2 and later)
 - Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED)
 - Drop statistics reported per queue for each of four priority-based drop profiles
 - Four levels of strict priorities with priority propagation among scheduling levels
 - Hierarchical shaping and hierarchical scheduler
 - Virtual Router Redundancy Protocol (VRRP) support
 - Fine-grained queuing and shaping per logical interface at both ingress and egress
 - 802.1q virtual LANs (VLANs)
 - VLAN stacking and rewriting
 - Channels defined by two stacked VLAN tags
 - Multiple tag protocol identifiers (TPID) support
 - IP service for nonstandard TPID and stacked VLAN tags
 - 802.1p rewrite per channel
 - Flexible mapping of channels and scheduler resources at both ingress and egress
 - Flexible Ethernet encapsulation
 - MAC learning, policing, accounting, and filtering

- Cables and connectors
- You can install any transceiver supported by the PIC.
 NOTE: Do not install SONET/SDH SFPs in the Gigabit Ethernet port. The port will not recognize the SFP.
 - Fiber-optic small form-factor pluggable transceivers (SFPs):
 - Duplex LC/PC connector (Rx and Tx)
 - 1000Base-LH (model number: SFP-1GE-LH)
 - 1000Base-LX (model number: SFP-1GE-LX)
 - 1000Base-SX (model number: SFP-1GE-SX)
 - Optical interface specifications—see [“Gigabit Ethernet 1000BASE Optical Interface Specifications” on page 32](#)
 - 1000Base-BX (model number pairs: SFP-GE10KT13R14 with SFP-GE10KT14R13, SFP-GE10KT13R15 with SFP-GE10KT15R13, SFP-GE40KT13R15 with SFP-GE40KT15R13)—see [“Fast Ethernet and Gigabit Ethernet Bidirectional SFP Optical Interface Specifications” on page 28](#)
 - Copper transceivers:
 - Connector: Four-pair, Category 5 shielded twisted-pair connectivity through an RJ-45 connector
 - 1000Base-T (model number: SFP-1GE-T)
 - Copper interface specifications—see [“Gigabit Ethernet 1000BASE-T Copper Interface Specifications” on page 35](#)

LEDs

OK or Status LED, one tricolor:

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

APP LED, one bicolor:

- Off—Monitoring application is not running.
- Green—Monitoring application is running under acceptable load.

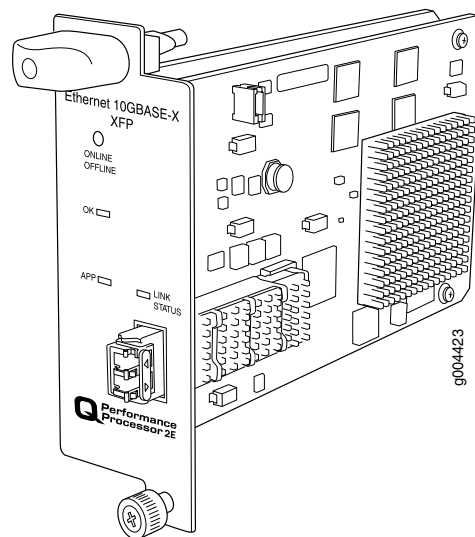
Port LEDs, one per port:

- Off—Port is not enabled.
- Green—Port is online with no alarms or failures.

Related Documentation

- [T640 PIC Description](#)
- [T640 PIC Combination Limitations](#)
- [T640 PICs Supported on page 3](#)

10-Gigabit Ethernet Enhanced IQ2 (IQ2E) PIC with XFP (T640 Router)



Software release

- Junos OS Release 9.4 and later (Type 3)
For information on which FPCs support this PIC, see "[T640 PIC/FPC Compatibility](#)" on [page 12](#).

Description

- One 10-Gigabit Ethernet port
- Power requirements: 1.2 A @48 V (56 W)
- Model number: PC-1XGE-TYPE3-XFP-IQ2E

Hardware features	• High-performance throughput • WAN-PHY mode at 9.953 Gbps • LAN-PHY mode at 10.3125 Gbps • Full-duplex mode • Large maximum transmission units (MTUs) of up to 9192 bytes
Software features	• Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) • Drop statistics reported per queue for each of four priority-based drop profiles • Four levels of strict priorities with priority propagation among scheduling levels • Hierarchical shaping and hierarchical scheduler • Configurable WAN-PHY mode options: • loopback • mpls • path-trace • trigger • Virtual Router Redundancy Protocol (VRRP) support • Fine-grained queueing and shaping per logical interface at both ingress and egress • 802.1q virtual LANs (VLANs) • VLAN stacking and rewriting • Channels defined by two stacked VLAN tags • Multiple tag protocol identifiers (TPID) support • IP service for nonstandard TPID and stacked VLAN tags • 802.1p rewrite per channel • Flexible mapping of channels and scheduler resources at both ingress and egress • 16,000 schedulers (2,000 schedulers with 8 queues each or 4,000 schedulers with 4 queues each) • Scheduler resources dynamically allocated across ports • Flexible Ethernet encapsulation • MAC learning, policing, accounting, and filtering
Cables and connectors	• You can install any transceiver supported by the PIC. • Fiber-optic 10-Gigabit small form-factor pluggable (XFP) transceivers: • Duplex LC/PC connector (Rx and Tx) • 10-Gigabit Ethernet XFP transceivers: • 10GBASE-S (model number: XFP-10G-S) • 10GBASE-L (model number: XFP-10G-L-OC192-SR1) • 10GBASE-E (model number: XFP-10G-E-OC192-IR2) • 10GBASE-Z (model number: XFP-10G-Z-OC192-LR2) Optical interface specifications—see “10-Gigabit Ethernet 10GBASE Optical Interface Specifications” on page 36

LEDs

OK LED, one tricolor:

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

APP LED, one:

- Off—Monitoring application is not running.
- Green—Monitoring application is running under acceptable load.
- Yellow—Monitoring application is overloaded.

Link Status LED, one:

- Off—Port is down.
 - Green—Port is online. Link is established.
-

**Related
Documentation**

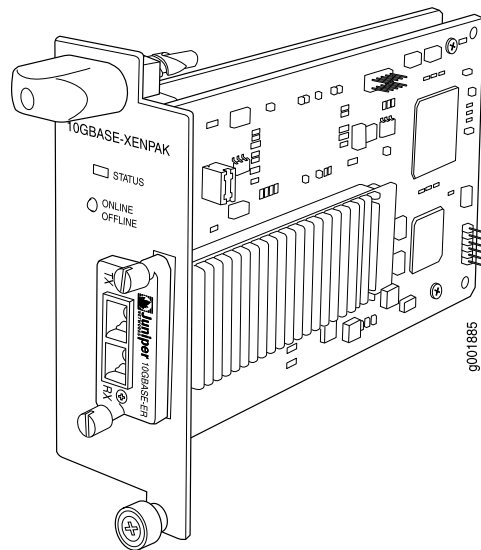
- *T640 PIC Description*
- *T640 PIC Combination Limitations*
- [T640 PICs Supported on page 3](#)

CHAPTER 11

10-Gigabit Ethernet PIC Descriptions

- 10-Gigabit Ethernet PIC with XENPAK (T640 Router) on page 129
- 10-Gigabit Ethernet DWDM PIC (T640 Router) on page 131
- 10-Gigabit Ethernet DWDM OTN PIC (T640 Router) on page 133
- 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (T640 Router) on page 134
- 10-Gigabit Ethernet LAN/WAN PIC with XFP (T640 Router) on page 137

10-Gigabit Ethernet PIC with XENPAK (T640 Router)



Software release

- Junos OS Release 6.2 and later (Type 3): 10GBASE-ER and 10GBASE-ZR transceivers
- Junos OS Release 7.1 and later (Type 3): 10GBASE-SR and 10GBASE-ZR transceivers

For information on which FPCs support this PIC, see ["T640 PIC/FPC Compatibility"](#) on page 12.

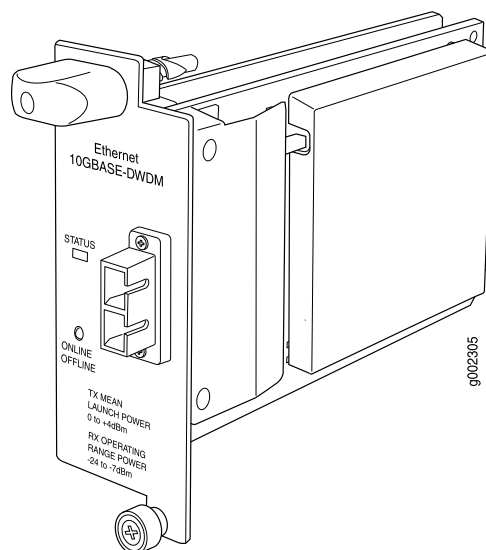
Description

- One 10-Gigabit Ethernet port
 - Power requirement: 0.55 A @ 48 V (26.6 W)
 - Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network
 - Model number: PC-1XGE-XENPAK
-

Hardware features	• High-performance throughput at speeds up to 10 Gbps • Full-duplex mode • Maximum transmission units (MTUs) up to 9192 bytes • 64 source MAC address filters • 960 destination MAC filters
Software features	• Virtual Router Redundancy Protocol (VRRP) support • 802.1q virtual LANs (VLANs) support • 802.3ad link aggregation support • RMON EtherStats • Optical diagnostics and related alarms (Junos OS Release 8.1 and later): • Transceiver temperature • Laser bias current • Laser output power • Receive optical power
Cables and connectors	• Duplex SC/PC connector (RX and TX) • 10-Gigabit Ethernet XENPAK transceivers: • 10GBASE-SR, LAN Rate (model number: XENPAK-1XGE-SR) • 10GBASE-LR, LAN Rate (model number: XENPAK-1XGE-LR) • 10GBASE-ER, LAN Rate (model number: XENPAK-1XGE-ER) • 10GBASE-ZR, LAN Rate (model number: XENPAK-1XGE-ZR) EOL (see notification PSN-2010-02-649) Optical interface specifications—see “10-Gigabit Ethernet 10GBASE Optical Interface Specifications” on page 36.
LEDs	Status LED, one bicolor: • Off—PIC not enabled. • Green—PIC is operating normally. • Red—PIC has an error or failure. Port LEDs, one pair: • Link—If green, the port is online; if there is no light, the port is down. • RX—If flashing green, the port is receiving data; if there is no light, the port might be on but is not receiving data.

- Related Documentation**
- *T640 PIC Description*
 - *T640 PIC Combination Limitations*
 - [T640 PICs Supported on page 3](#)

10-Gigabit Ethernet DWDM PIC (T640 Router)



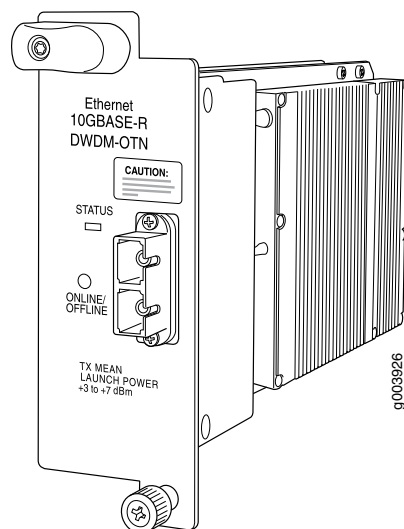
Software release	Junos OS Release 7.5 and later (Type 3) For information on which FPCs support this PIC, see “T640 PIC/FPC Compatibility” on page 12.
Description	- One 10-Gigabit Ethernet port - Power requirement: 0.55 A @ 48 V (26.6 W) - Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network - Model number: PC-1XGE-DWDM-CBAND
Hardware features	- C-band ITU-Grid with 100 GHz spacing - High-performance throughput at speeds up to 10 Gbps - Full-duplex mode - Maximum transmission units (MTUs) up to 9192 bytes 64 source MAC address filters 960 destination MAC filters 45 individual wavelengths: 1528.77 nm, 1529.55 nm, 1530.33 nm, 1531.12 nm, 1531.90 nm, 1532.68 nm, 1533.47 nm, 1534.25 nm, 1535.04 nm, 1535.82 nm, 1536.61 nm, 1537.40 nm, 1538.19 nm, 1538.98 nm, 1539.77 nm, 1540.56 nm, 1541.35 nm, 1542.14 nm, 1542.94 nm, 1543.73 nm, 1544.53 nm, 1545.32 nm, 1546.12 nm, 1546.92 nm, 1547.72 nm, 1548.52 nm, 1549.32 nm, 1550.12 nm, 1550.92 nm, 1551.72 nm, 1552.52 nm, 1553.33 nm, 1554.13 nm, 1554.94 nm, 1555.75 nm, 1556.56 nm, 1557.36 nm, 1558.17 nm, 1558.98 nm, 1559.79 nm, 1560.61 nm, 1561.42 nm, 1562.23 nm, 1563.05 nm, 1563.86 nm
Software features	- Enhanced optical monitoring capabilities - CLI configurable wavelength support - Virtual Router Redundancy Protocol (VRRP) support 802.1q virtual LANs (VLANs) support 802.3ad link aggregation support - RMON EtherStats

Cables and connectors	• Duplex SC/PC connector (RX and TX) • Dense wavelength division multiplexing (DWDM) optical transport network (OTN) transceiver: • Extra-Long Wavelength Serial DWDM, LAN Rate (model number: PC-1XGE-DWDM-OTN) Optical interface specifications—see "10-Gigabit Ethernet DWDM Optical Interface Specifications" on page 41
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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: • Link—If green, the port is online; if there is no light, the port is down. • RX—If flashing green, the port is receiving data; if there is no light, the port might be on but is not receiving data.
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Related Documentation	• <i>T640 PIC Description</i> • <i>T640 PIC Combination Limitations</i> • T640 PICs Supported on page 3
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10-Gigabit Ethernet DWDM OTN PIC (T640 Router)



Software release	Junos OS Release 9.4 and later (Type 3) For information on which FPCs support this PIC, see “T640 PIC/FPC Compatibility” on page 12.
Description	- One 10-Gigabit Optical Transport Network (OTN) port for transport of 10-Gigabit Ethernet (10GBASE-R) traffic - Power requirement: 0.55 A @ 48 V (26.6 W) - Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network - Model number: PC-1XGE-DWDM-OTN
Hardware features	- C-band ITU-Grid with 50 GHz spacing - High-performance throughput at speeds up to 10 Gbps - Full-duplex mode - Maximum transmission units (MTUs) up to 9192 bytes 64 source MAC address filters 960 destination MAC filters 89 individual wavelengths
Software features	- Enhanced optical monitoring capabilities - CLI configurable wavelength support - Virtual Router Redundancy Protocol (VRRP) support 802.1q virtual LANs (VLANs) support - IEEE 802.3ad Link Aggregation - RMON EtherStats
Cables and connectors	- Duplex SC/PC connector (RX and TX) - Fixed transceiver - Dense wavelength division multiplexing (DWDM) optical transport network (OTN) transceiver. Optical interface specifications—see <i>10-Gigabit Ethernet DWDM OTN Optical Interface Specifications</i> and <i>“10-Gigabit Ethernet 10GBASE Optical Interface Specifications” on page 36</i>.

LEDs

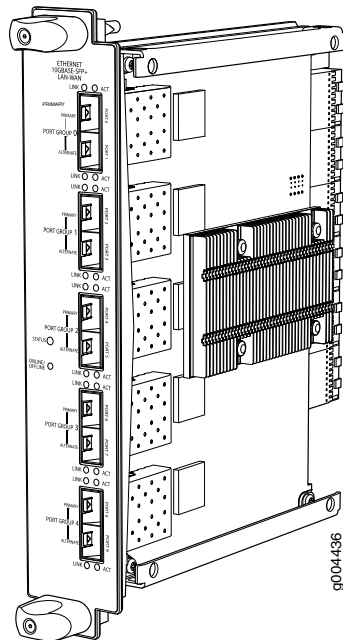
Status LED, one bicolor:

- Off—PIC is not enabled.
- Green—PIC is operating normally.
- Red—PIC has an error or is in line-side loopback.

**Related
Documentation**

- [T640 PIC Description](#)
- [T640 PIC Combination Limitations](#)
- [T640 PICs Supported on page 3](#)

10-Gigabit Ethernet LAN/WAN PIC with SFP+ (T640 Router)



Software release

- Junos OS Release 10.1 and later (Type 4)

For information on which FPCs support this PIC, see [“T640 PIC/FPC Compatibility” on page 12](#).

NOTE: In some Juniper Networks documentation, the 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (PD-5-10XGE-SFPP) is referred to as the 10-port 10-Gigabit Oversubscribed Ethernet PIC. In oversubscribed Ethernet mode (default), all 10 ports are enabled and oversubscription is permitted. In line-rate mode, this PIC does not allow oversubscription and supports only 5 ports (0, 2, 4, 6, and 8).

Description

- Ten 10-Gigabit Ethernet SFP+ ports (only ports 0, 2, 4, 6, and 8 are supported in line-rate mode)
- Total bandwidth: 50 Gbps
- Power requirements: 3.3 A @ -48 V (158.4 W)
- Model number: PD-5-10XGE-SFPP

Hardware features	• High-performance throughput: • WAN-PHY mode at 9.953 Gbps • LAN-PHY mode at 10.3 Gbps • Full-duplex mode • Large maximum transmission units (MTUs) of up to 9192 bytes
Software features	• Two modes of operation: 5 ports in line-rate mode, 10 ports in oversubscribed mode • Intelligent handling of oversubscribed traffic • Flexible mapping of port-assigned queues and scheduler resources at both ingress and egress • Strict-priority queue available on a per-port basis • QoS available on a per-port basis • Weighted round-robin (WRR) • Layer 2 protocol support: • Ethernet CCC, Ethernet TCC, Ethernet VPLS • VLAN CCC • Extended VLAN TCC • VLAN VPLS • Flexible Ethernet services • Layer 3 protocol support • IPv4 • IPv6 • MPLS • VLAN support • 4000 VLANs per PIC • Flex-VLAN tagging support • Interrupt-driven link-down detection • Pause frame support • Jumbo frame support • MAC learning, aging, policing, and filtering • Virtual Router Redundancy Protocol (VRRP) support • IEEE 802.3ad link aggregation (For routers in a routing matrix, Junos OS Release 11.2 and later is required) NOTE: For PICs that support oversubscription, the PIC must be in line-rate mode to support aggregated Ethernet. • DSCP rewrite is supported for Junos OS Release 11.4 and later.

- Cables and connectors
- Duplex LC/PC connector (Rx and Tx)
 - 10-Gigabit SFP+ transceivers:
 - 10GBASE-ER (model number: SFPP-10GE-ER) Junos OS Release 12.1 and later
 - 10GBASE-LR (model number: SFPP-10GE-LR)
 - 10GBASE-SR (model number: SFPP-10GE-SR)
 - 10GBASE-ZR (model number: SFPP-10GE-ZR) Junos OS Release 12.3 and later
 - 10GBASE-ZR (model number: SFPP-10G-OTN-XT)
 - Supported in Junos OS Release 12.3R5, 13.2R3, 13.3, and later
 - NESB compliant
 - Dual-rate extended temperature transceiver that supports LAN-PHY and WAN-PHY modes, and OTN rates
 - Optical interface specifications—see [“10-Gigabit Ethernet 10GBASE Optical Interface Specifications” on page 36](#)

LEDs

STATUS LED, one tricolor:

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

Port LEDs, one pair for each port:

- **LINK LED**
 - Off—Port is not enabled.
 - Green—Port is online with no alarms or failures.
 - Red—The router has detected a failure with alarms.
- **ACT LED**
 - Green flashing—Port is sending or receiving packets.
 - Off—No packet activity detected on the port.



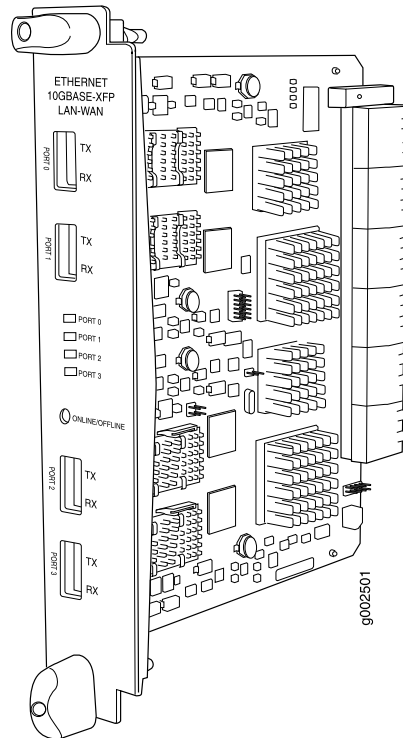
CAUTION: A T640 router with the following configurations and operating conditions can accommodate a maximum of eight 10-Gigabit Ethernet LAN/WAN with SFP+ PICs:

- One or two AC power supplies.
- Two DC power supplies in load-sharing mode with an input voltage between –43 VDC and –72 VDC.
- One DC power supply with an input voltage between –43 VDC and –72 VDC.

However, a router with only one DC power supply with an input voltage between –40 VDC and –43 VDC might not be able to support the maximum number of 10-Gigabit Ethernet LAN/WAN with SFP+ PICs. For more information, see technical bulletin [SN-2010-03-695](#).

- Related Documentation**
- [T640 PIC Description](#)
 - [T640 PIC Combination Limitations](#)
 - [T640 PIC/FPC Compatibility on page 12](#)

10-Gigabit Ethernet LAN/WAN PIC with XFP (T640 Router)



Software release	• Junos OS Release 9.0 and later (Type 4) For information on which FPCs support this PIC, see “T640 PIC/FPC Compatibility” on page 12.
Description	• Four 10-Gigabit Ethernet ports • Power requirements: 0.9 A @48 V (43 W) • Model number: PD-4XGE-XFP
Hardware features	• High-performance throughput • WAN-PHY mode at 9.953 Gbps • LAN-PHY mode at 10.3125 Gbps • Full-duplex mode • Large maximum transmission units (MTUs) of up to 9192 bytes

Software features	- Configurable WAN-PHY mode options: - loopback - mpls - path-trace - trigger - Optical diagnostics, monitoring, and alarms for XFP transceivers is supported in Junos OS Release 10.4 and later. - Flexible Ethernet Services Encapsulation 802.1q virtual LANs (VLANs) - Ethernet OAM 802.1ag continuity check - Ethernet OAM 802.3ah (remote loopback is not supported for this PIC) - VLAN stacking - Channels defined by two stacked VLAN tags - Multiple tag protocol identifiers (TPID) support - IP service for nonstandard TPID and stacked VLAN tags - Passive flow monitoring supported in Junos OS Release 11.2 and later - MAC learning, accounting, and filtering - Virtual Router Redundancy Protocol (VRRP) support
Cables and connectors	- You can install any transceiver supported by the PIC. - Connector: Duplex LC/PC (Rx and Tx) - Fiber-optic 10-Gigabit small form-factor pluggable (XFP) transceivers: 10GBASE-S (model number: XFP-10G-S) 10GBASE-L (model number: XFP-10G-L-OC192-SR1) 10GBASE-E (model number: XFP-10G-E-OC192-IR2) 10GBASE-Z (model number: XFP-10G-Z-OC192-LR2) - Optical interface specifications—see “10-Gigabit Ethernet 10GBASE Optical Interface Specifications” on page 36 - DWDM Tunable XFP transceivers: 10GBASE-ZR (model number: XFP-10G-CBAND-T50-ZR is supported in Junos OS Release 10.2 and later) DWDM supported wavelengths—see “10-Gigabit Ethernet DWDM Transceiver Wavelengths” on page 41 - Optical interface specifications—see “10-Gigabit Ethernet 10GBASE Optical Interface Specifications” on page 36
LEDs	Port LED, one for each port: - Off—Port is not enabled. - Green—Port is online with no alarms or failures. - Yellow—Port is online with alarms for remote failures. - Red—The router has detected a failure with alarms for local failures.

Alarms Alarms are vendor-specific. Some transceiver vendors might not support every alarm.

- Input laser power
- Input loss of lock
- Input loss of signal
- Input Rx path
- Output A/D data not ready
- Output CDR (clock data recovery)
- Output laser bias current
- Output laser power
- Output laser safety
- Output Tx path
- Module temperature
- Module MOD_NR (module not ready)
- Module P_DOWN (module down)
- Module unplugged or down
- Wire unplugged or down

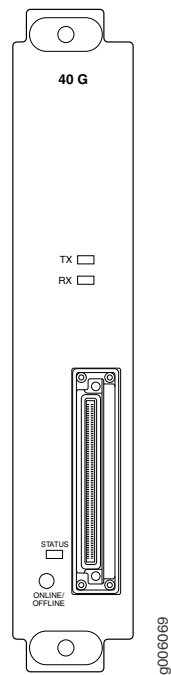
- Related Documentation**
- *T640 PIC Description*
 - *T640 PIC Combination Limitations*
 - [T640 PICs Supported on page 3](#)

CHAPTER 12

40-Gigabit Ethernet PIC Descriptions

- 40-Gigabit Ethernet PIC with CFP (T640 Router) on page 141

40-Gigabit Ethernet PIC with CFP (T640 Router)



Software release	• Junos OS Release 11.4 (Type 4) For information on which FPCs support this PIC, see “T640 PIC/FPC Compatibility” on page 12.
Description	• One 40-Gigabit Ethernet port • Power requirement: 1.46 A @ –48 V (70.0 W) • Model number: PD-1XLE-CFP
Hardware features	• Maximum transmission units (MTUs) up to 9192 bytes

Software features

- Media Access Control (MAC) accounting
NOTE: MAC accounting on this PIC is not supported when aggregated Ethernet is configured.
 - Source and destination MAC address filtering
 - Ethernet OAM 802.3ah (remote loopback is not supported for this PIC)
 - Layer 2 filtering and accounting based on Layer 2 headers
 - Multiple tag protocol identifiers (TPIDs) used for filtering and counting
 - Flexible virtual LAN (VLAN) tagging
 - Channels defined by two stacked VLAN tags
 - Layer 2 protocols:
 - Flexible Ethernet service
 - Ethernet circuit cross-connect (CCC)
 - Ethernet translational cross-connect (TCC)
 - Ethernet virtual private LAN service (VPLS)
 - VLAN CCC
 - Extended VLAN TCC
 - VLAN VPLS
 - Layer 3 protocols:
 - IPV4
 - IPV6
 - MPLS
 - Optical control features (vendor dependent)
 - IEEE 802.3ad Link Aggregation
 - Graceful Routing Engine switchover (GRES)
- NOTE:** The 40-Gigabit Ethernet PIC with CFP does not support Layer 2 egress interface rewrite rules (**egress IEEE802.1P rewrite-rules**).

Cables and connectors

- Duplex SC/PC connector (RX and TX)
- 40-Gigabit Ethernet CFP transceiver: 40GBASE-LR4 (model number: CFP-40GBASE-LR4)
- Optical interface specifications—see [“40-Gigabit Ethernet 40GBASE-R Optical Interface Specifications” on page 43](#)

LEDs

STATUS LED:

- Green—Online with no alarms or failures
- Yellow—PIC is initializing
- Red—PIC has a remote or local fault
- Off—Not enabled

RX LED:

- Green—Port is receiving data
- Off—Port might be on, but there is a local or remote fault

TX LED:

- Green—Port is transmitting data
- Off—Port might be on, but there is a local fault

Alarms, errors, and events

- Alarm indication signal (AIS)
- Laser bias current high/low alarms and warnings
- Laser Rx power high/low alarms and warnings
- Module not ready alarm
- Module power down alarm
- Module temperature high/low alarms and warnings
- Rx CDR loss of lock alarm
- Rx loss of signal alarm
- Rx not ready alarm
- Tx CDR loss of lock alarm
- Tx data not ready alarm
- Tx laser fault alarm
- Tx not ready alarm

- Related Documentation**
- [T640 PIC Description](#)
 - [T640 PICs Supported on page 3](#)

CHAPTER 13

Services PIC Descriptions

- MultiServices PICs (T640 Router) on page 145
- Tunnel Services PIC (T640 Router) on page 149
- 40-Gigabit Tunnel Services PIC (T640 Router) on page 150

MultiServices PICs (T640 Router)

Figure 18: MultiServices 100 PIC

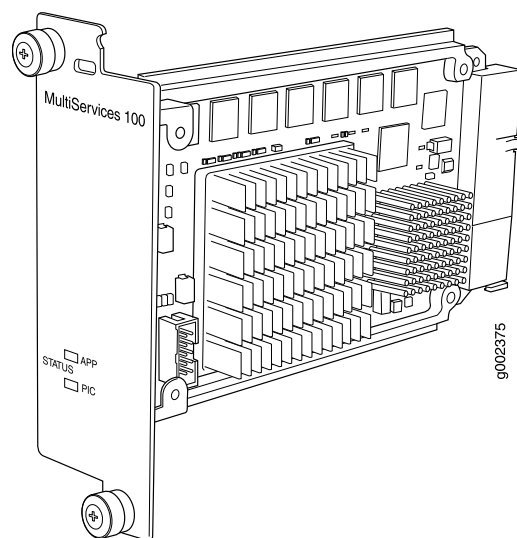


Figure 19: MultiServices 400 PIC

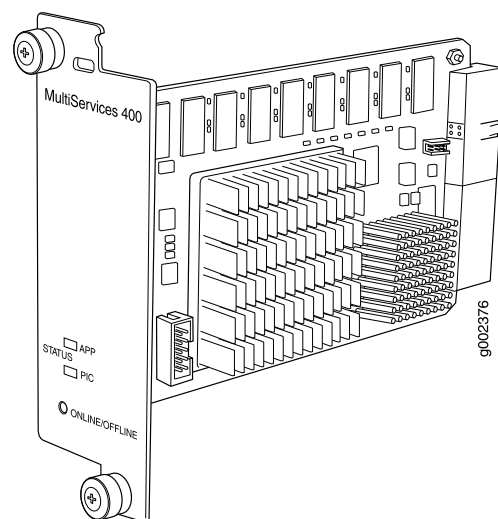
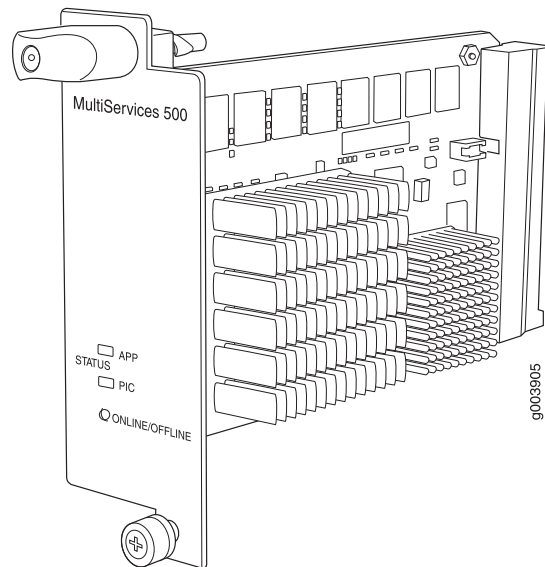


Figure 20: Center: MultiServices 500 PIC



Software release	- MultiServices 100: Junos OS Release 8.1 and later (Type 1) - MultiServices 400: Junos OS Release 8.1R2 and later (Type 2) - MultiServices 500: Junos OS Release 8.3 and later (Type 3) For information on which FPCs support these PICs, see “T640 PIC/FPC Compatibility” on page 12.
Description	- Supports tunnel services. This feature is included with the PIC and does not require an individual license. - Individual licenses must be purchased for additional services. - Power requirement: - Type 1: 0.52 A @ 48 V (25 W) - Type 2: 0.69 A @ 48 V (33 W) - Type 3: 0.83 A @ 48 V (40 W) - Model number for MultiServices 100 PIC: PB-MS-100-1 - Model number for MultiServices 400 PIC: PB-MS-400-2 - Model number for MultiServices 500 PIC: PB-MS-500-3
Hardware features	- Active monitoring on: - Type 1: up to 1.6 million flows - Type 2: up to 3.2 million flows - Type 3: up to 3.2 million flows
Software features	- Support for up to 2000 service sets - Support for MTUs up to 9192 bytes for Gigabit Ethernet and SONET interfaces Depending on your Junos OS Release and individual licenses, software features for this PIC can include the features listed in Table 51 on page 147. For more information about the software features available for services PICs, see the <i>Junos OS Services Interfaces Library for Routing Devices</i>.

LEDs	Status LED, one tricolor: • Off—PIC is offline and it is safe to remove it from the chassis. • Green—PIC is operating normally. • Yellow—PIC is initializing. • Red—PIC has an error or failure and no further harm can be done by removing it from the chassis. Application LED, one bicolor: • Off—Service is not running. • Green—Service is running under acceptable load. • Yellow—Service is overloaded.
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Table 51: MultiServices PICs Software Features Supported on the T640 Router

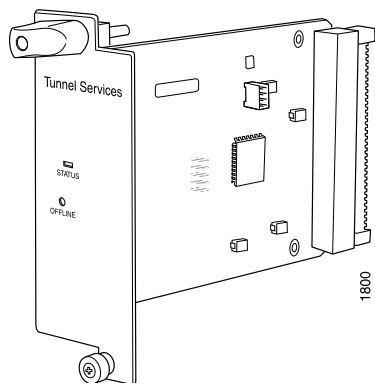
Software Feature	MultiServices 100	MultiServices 400	MultiServices 500
GRE Key	–	–	–
GRE dont-fragment	–	–	–
Stateful firewall with packet inspection: detects SYN attacks, ICMP and UDP floods, and ping-of-death attacks	8.1	8.1R2	8.3
Network Address Translation (NAT) for IP addresses	8.1	8.1R2	8.3
Port Address Translation (PAT) for port numbers	8.1	8.1R2	8.3
IP Security (IPSec) encryption	8.1	8.1R2	8.5
Active flow monitoring exports cflowd version 5 and version 8 records	8.1	8.1R2	8.3
Active flow monitoring exports flow monitoring version 9 records, based on RFC 3954	8.3	8.3	8.5
Passive flow monitoring	–	8.4	–
Passive flow collection	–	8.5	–
Flow-tap	8.2	8.2	8.5
Dynamic flow capture	–	8.4	–
Real-time performance monitoring	8.3	8.3	8.3
Link services	8.1	8.1R2	8.5

Table 51: MultiServices PICs Software Features Supported on the T640 Router (*continued*)

Software Feature	MultiServices 100	MultiServices 400	MultiServices 500
Tunnel services:	8.1	8.1R2	8.3
• IP-IP unicast tunneling • GRE unicast tunneling—Supports GRE fragmentation • Protocol Independent Multicast (PIM) sparse mode unicast tunneling			
Virtual tunnel interface for Layer 3 VPNs	8.1	8.1R2	8.3
Layer 2 Tunneling Protocol (L2TP)	—	—	—
Voice services:	8.1	8.1R2	8.5
• Compressed Real-Time Transport Protocol (CRTP)			
Encapsulations:	8.1	8.1R2	8.3
• Multilink Frame Relay (MLFR) • Multilink Point-to-Point Protocol (MLPP)			

- Related Documentation**
- *T640 PIC Description*
 - *T640 PIC Combination Limitations*
 - [T640 PICs Supported on page 3](#)

Tunnel Services PIC (T640 Router)



Software release	- Junos OS Release 8.0 and later (Type 1) - Junos OS Release 6.1 and later (Type 2) - Junos OS Release 5.3 and later (Type 3) For information on which FPCs support these PICs, see “T640 PIC/FPC Compatibility” on page 12.
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Description	- Power requirement: 0.07 A @ 48 V (3.4 W) - Model number for Type 1 Tunnel Services PIC: PB-TUNNEL-1 - Model number for Type 2 Tunnel Services PIC: PB-TUNNEL - Model number for Type 3 Tunnel Services PIC: PC-TUNNEL
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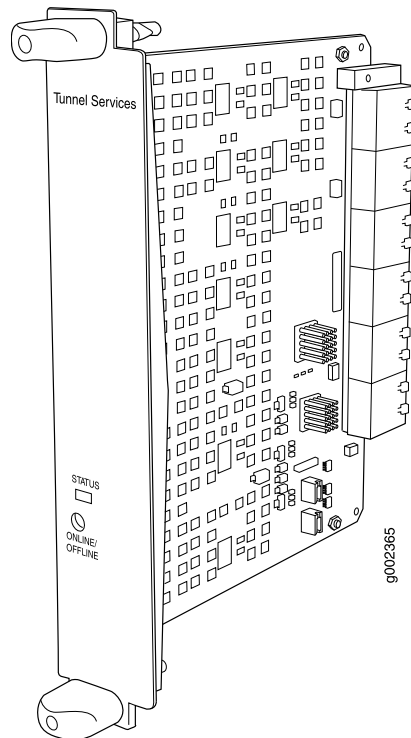
Hardware features	- Loopback function that encapsulates and de-encapsulates packets - OC12/STM4 tunneling bandwidth on Type 1 FPC; OC48/STM16 tunneling bandwidth on Type 2 FPC; OC192/STM64 tunneling bandwidth on Type 3 FPC
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Software features	For a list of the software features available for services PICs, see the <i>Junos OS Services Interfaces Library for Routing Devices</i>. - IP-IP unicast tunneling - GRE unicast tunneling - PIM sparse mode unicast tunneling
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LEDs	One tricolor: - Off—Not enabled - Green—Online with no alarms or failures - Yellow—Online with alarms for remote failures - Red—Active with a local alarm; router has detected a failure
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Related Documentation	T640 PIC Description T640 PIC Combination Limitations T640 PICs Supported on page 3
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40-Gigabit Tunnel Services PIC (T640 Router)



Software release	Junos OS Release 8.0 and later (Type 4) For information on which FPCs support this PIC, see “T640 PIC/FPC Compatibility” on page 12.
Description	- Power requirement: 0.07 A/48 V @ 3.4 W - Model number: PD-TUNNEL
Hardware features	40 gigabit loopback bandwidth that encapsulates and de-encapsulates packets
Software features	For a list of the software features available for services PICs, see the <i>Junos OS Services Interfaces Library for Routing Devices</i>. - IP-IP unicast tunneling - GRE unicast tunneling - PIM sparse mode unicast tunneling
LEDs	One tricolor: - Off—Not enabled - Green—Online with no alarms or failures - Yellow—Online with alarms for remote failures - Red—Active with a local alarm; router has detected a failure

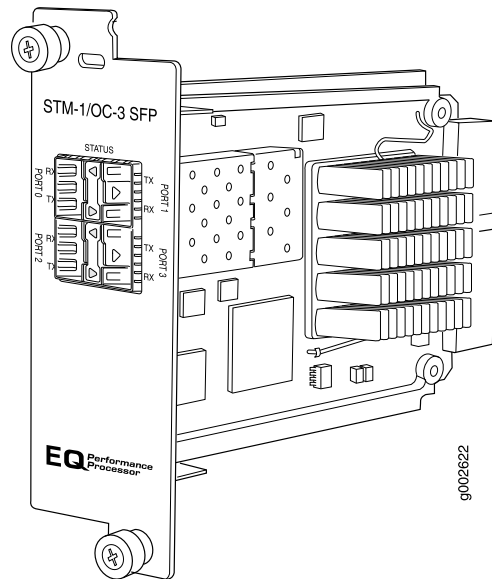
- Related Documentation**
- *T640 PIC Description*
 - *T640 PIC Combination Limitations*
 - [T640 PICs Supported on page 3](#)

CHAPTER 14

SONET/SDH PIC Descriptions

- [SONET/SDH OC3/STM1 Enhanced IQ \(IQE\) PIC with SFP \(T640 Router\) on page 154](#)
- [SONET/SDH OC3/STM1 \(Multi-Rate\) PICs with SFP \(T640 Router\) on page 157](#)
- [SONET/SDH OC12/STM4 Enhanced IQ \(IQE\) PIC with SFP \(T640 Router\) on page 160](#)
- [SONET/SDH OC12/STM4 \(Multi-Rate\) PICs with SFP \(T640 Router\) on page 163](#)
- [SONET/SDH OC48c/STM16 PIC with SFP \(T640 Router\) on page 166](#)
- [SONET/SDH OC48/STM16 Enhanced IQ \(IQE\) PIC with SFP \(T640 Router\) on page 169](#)
- [SONET/SDH OC48/STM16 \(Multi-Rate\) PIC with SFP \(T640 Router\) on page 173](#)
- [SONET/SDH OC192c/STM64 PIC \(T640 Router\) on page 176](#)
- [SONET/SDH OC192c/STM64 PICs with XFP \(T640 Router\) on page 179](#)
- [SONET/SDH OC768c/STM256 PIC \(T640 Router\) on page 182](#)

SONET/SDH OC3/STM1 Enhanced IQ (IQE) PIC with SFP (T640 Router)



Software release	Junos OS Release 9.3R2 and later (Type 1) For information on which FPCs support this PIC, see “T640 PIC/FPC Compatibility” on page 12.
Description	- Four OC3 or STM1 ports - SONET or SDH is configurable on a per-port granularity - Power requirement: 0.6 A @ 48 V (28.8 W) - Model number: PB-4OC3-STM1-IQE-SFP
Hardware features	- Top row: Ports are numbered 0 and 1 from left to right - Bottom row: Ports are numbered 2 and 3 from left to right

Software features	• Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) • Enhanced fine-grained queuing per logical interface. See the <i>Class of Service Feature Guide for Routing Devices</i> for more information about class of service features. • Packet buffering, Layer 2 parsing • Local line and remote payload loopback testing • Simple Network Management Protocol (SNMP): OC3 MIB • Encapsulations: • Circuit cross-connect (CCC) • Translational cross-connect (TCC) • Extended Frame Relay for CCC and TCC • Flexible Frame Relay • Frame Relay • Frame Relay for CCC • Frame Relay for TCC • Frame Relay port CCC • High-Level Data Link Control (HDLC) • HDLC framing for CCC • HDLC framing for TCC • MPLS CCC • MPLS TCC • Multilink Frame Relay (MLFR) UNI NNI (MFR FRF.16) • Point-to-Point Protocol (PPP) • PPP for CCC • PPP for TCC
Cables and connectors	• Duplex LC/PC connector (Rx and Tx) • SONET/SDH OC3/STM1 fiber-optic SFP transceivers: • Multimode (model number: SFP-OC3-SR) • Intermediate reach (IR-1) (model number: SFP-OC3-IR) • Long reach (LR-1) (model number: SFP-OC3-LR) Optical interface specifications—see “SONET/SDH OC3/STM1 Optical Interface Specifications” on page 46
LEDs	One tricolor Status LED per port: • Off—Not enabled. • Green—Online with no alarms or failures. • Yellow—Online with alarms for remote failures. • Red—Active with a local alarm; router has detected a failure.
Alarms, errors, and events	• SONET alarms: • Alarm indication signal—line (AIS-L) • Alarm indication signal—path (AIS-P) • Bit error rate—signal degrade (BERR-SD) • Bit error rate—signal fail (BERR-SF) • Loss of frame (LOF) • Loss of light (LOL)

- Loss of pointer (LOP)
- Loss of signal (LOS)
- Payload label mismatch (PLM-P)
- Phase lock loop (PLL)
- Remote defect indication—line (RDI-L)
- Remote defect indication—path (RDI-P)
- Remote error indication (REI)
- Payload unequipped (unequipped STS at path level) (UNEQ-P)
- Severely errored frames (SEF)
- SDH alarms:
 - Administrative unit alarm indication signal (AU-AIS)
 - Bit error rate signal degrade (BERR-SD)
 - Bit error rate signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1, B2, B3
 - Higher order path—alarm indication signal (HP-AIS)
 - Higher order path—far-end receive failure (HP-FERF)
 - Higher order path—payload label mismatch (HP-PLM)
 - Higher order path—loss of pointer (HP-LOP)
 - Higher order path—remote defect indication (HP-RDI)
 - Higher order path—unequipped (HP-UNEQ)
 - Loss of frame (LOF)
 - Loss of light (LOL)
 - Loss of signal (LOS)
 - Multiplex section—alarm indication signal (MS-AIS)
 - Multiplex section—far-end receive failure (MS-FERF)
 - Multiplex section—remote defect indication (MS-RDI)
 - Multiplex section—remote error indication (MS-REI)
 - Phase lock loop (PLL)
 - Remote error indication (REI)
 - Severely errored frames (SEF)
- Error detection:
 - Errored seconds (ES-S, ES-L, ES-P)
 - Severely errored framing seconds (SEFS-S)
 - Severely errored seconds (SES-S, SES-L, SES-P)
 - Unavailable seconds (UAS-L, UAS-P)

**Related
Documentation**

- [T640 PIC Description](#)
- [T640 PIC Combination Limitations](#)
- [T640 PICs Supported on page 3](#)

SONET/SDH OC3/STM1 (Multi-Rate) PICs with SFP (T640 Router)

Figure 21: SONET/SDH OC3/STM1 (Multi-Rate) PIC (Type 1)

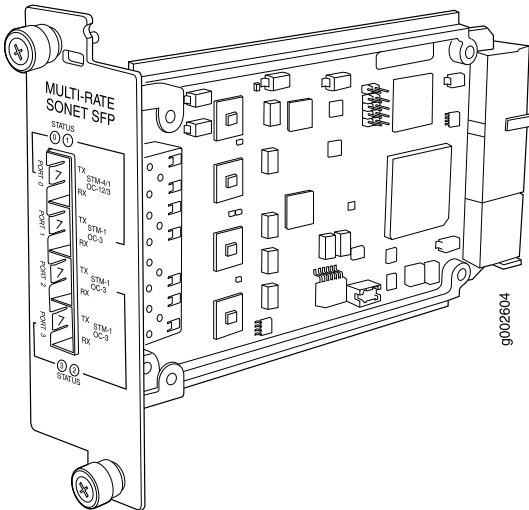
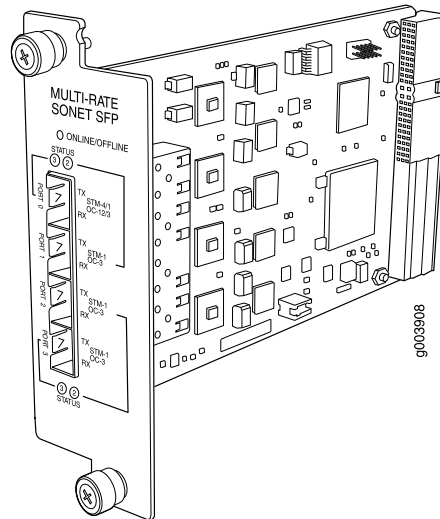


Figure 22: SONET/SDH OC3/STM1 (Multi-Rate) PIC (Type 2)



Software release

- 4-port: Junos OS Release 8.4 and later (Type 1)
- 4-port: Junos OS Release 8.3 and later (Type 2)

For information on which FPCs support these PICs, see [“T640 PIC/FPC Compatibility”](#) on page 12.

Description

- Rate-selectable using one of the following rates:
 - 1-port OC12/STM4
 - 1-port OC12c/STM4c
 - 4-port OC3c/STM1c
- Power requirement: 0.40 A @ 48 V (19 W)
- Model number for SONET/SDH OC3/STM1 (Multi-Rate) Type 1 PIC: PB-4OC3-1OC12-SON-SFP
Model number for SONET/SDH OC3/STM1 (Multi-Rate) Type 2 PIC: PB-4OC3-1OC12-SON-SFP

Hardware features

- Multiplexing and demultiplexing
- Rate policing on input
- Rate shaping on output
- Packet buffering, Layer 2 parsing

Software features	• Optical diagnostics and related alarms • Per-port SONET/SDH framing • Link aggregation • Alarm and event counting and detection • Dual-router automatic protection switching (APS) • Multiprotocol Label Switching (MPLS) fast reroute • Encapsulations: • Circuit cross-connect (CCC) • Translational cross-connect (TCC) • Frame Relay • High-Level Data Link Control (HDLC) • Point-to-Point Protocol (PPP)
Cables and connectors	You can install any transceiver supported by the PIC. • Duplex LC/PC connector (Rx and Tx) • SONET/SDH OC3/STM1 small form-factor pluggable (SFP) transceivers: • Multimode (model number: SFP-OC3-SR) • Intermediate reach (IR-1) (model number: SFP-OC3-IR) • Long reach (LR-1) (model number: SFP-OC3-LR) Optical interface specifications—see “SONET/SDH OC3/STM1 Optical Interface Specifications” on page 46 • SONET/SDH OC12/STM4 small form-factor pluggable (SFP) transceivers: • Short reach (model number: SFP-OC12-SR) • Intermediate reach (IR-1) (model number: SFP-OC312-IR) • Long reach (LR-1) (model number: SFP-OC12-LR) Optical interface specifications—see “SONET/SDH OC12/STM4 Optical Interface Specifications” on page 48 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 CLI Explorer.
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

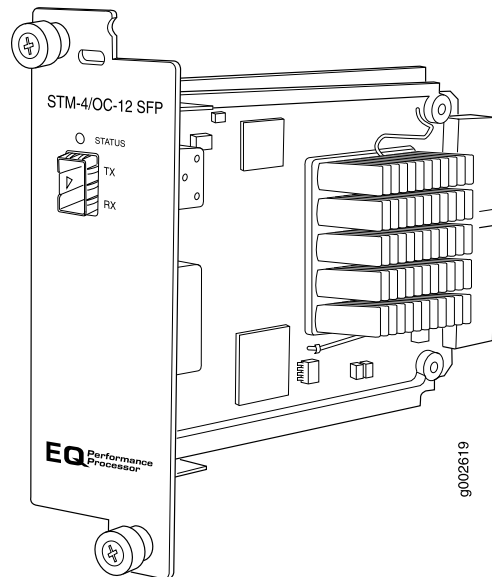
Alarms, errors, and events

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

Related Documentation

- *T640 PIC Description*
- *T640 PIC Combination Limitations*
- [T640 PICs Supported on page 3](#)

SONET/SDH OC12/STM4 Enhanced IQ (IQE) PIC with SFP (T640 Router)



Software release	Junos OS Release 9.3 and later (Type 1) For information on which FPCs support this PIC, see “T640 PIC/FPC Compatibility” on page 12.
Description	- One OC12/STM4 port - SONET or SDH is configurable on a per-port granularity - Power requirement: 0.58 A @ 48 V (27.8 W) - Model number: PB-1OC12-STM4-IQE-SFP
Hardware features	Port is numbered 0.
Software features	- Quality of service (QoS) per channel: weighted round-robin (WRR), random early detection (RED), weighted random early detection (WRED) - Enhanced fine-grained queuing per logical interface. See the <i>Class of Service Feature Guide for Routing Devices</i> for more information about class of service features. - Packet buffering, Layer 2 parsing - Local line and remote payload loopback testing - Encapsulations: - Circuit cross-connect (CCC) - Translational cross-connect (TCC) - Extended Frame Relay for CCC and TCC - Flexible Frame Relay - Frame Relay - Frame Relay for CCC - Frame Relay for TCC - Frame Relay port CCC - High-Level Data Link Control (HDLC) - HDLC framing for CCC

- HDLC framing for TCC
- MPLS CCC
- MPLS TCC
- Multilink Frame Relay (MLFR) UNI NNI (MFR FRF.16)
- Point-to-Point Protocol (PPP)
- PPP for CCC
- PPP for TCC
- Encapsulations available only for DS1:
 - Multilink Frame Relay end-to-end (MLFR FRF.15)
 - Multilink PPP (MLPPP)
 - PPP over Frame Relay

Cables and connectors

- Duplex LC/PC connector (Rx and Tx)
- SONET/SDH OC12/STM4 fiber-optic SFP transceivers:
 - Short reach (model number: SFP-OC12-SR)
 - Intermediate reach (IR-1) (model number: SFP-OC12-IR)
 - Long reach (LR-1) (model number: SFP-OC12-LR)

Optical interface specifications—see [“SONET/SDH OC12/STM4 Optical Interface Specifications” on page 48](#)

LEDs

One tricolor per port:

- Off—Not enabled
- Green—Online with no alarms or failures
- Yellow—Online with alarms for remote failures
- Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events

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

Instrumentation
(counters)

- Layer 2 per-queue and per-channel packet and byte counters

Related
Documentation

- *T640 PIC Description*
- *T640 PIC Combination Limitations*
- [T640 PICs Supported on page 3](#)

SONET/SDH OC12/STM4 (Multi-Rate) PICs with SFP (T640 Router)

Figure 23: 1-Port SONET/SDH OC12/STM4 (Multi-Rate) PIC

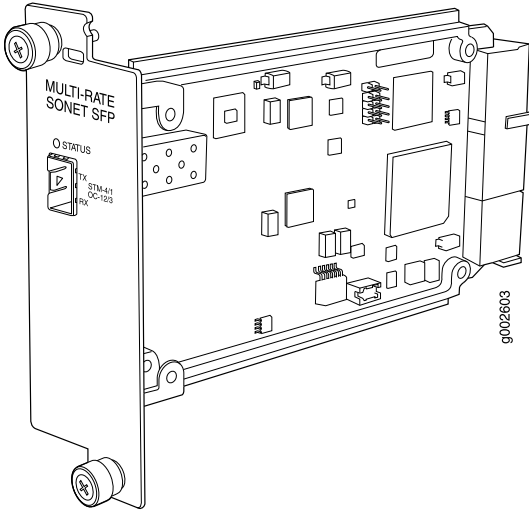
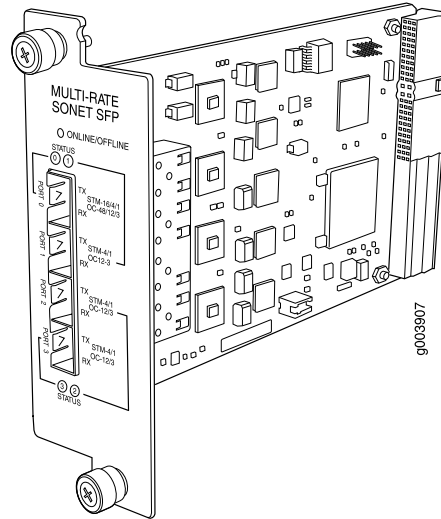


Figure 24: 4-Port SONET/SDH OC12/STM4 (Multi-Rate) PIC



Software release

- 1-port: Junos OS Release 8.4 and later (Type 1)
- 4-port: Junos OS Release 8.3 and later (Type 2)

For information on which FPCs support these PICs, see [“T640 PIC/FPC Compatibility”](#) on page 12.

Description

- 1-port: Rate-selectable using one of the following rates:
 - 1-port OC3/STM1
 - 1-port OC12/STM4
 - 1-port OC12c/STM4c
- 4-port: Rate-selectable using one of the following rates:
 - 1-port OC12/STM4
 - 1-port OC48/STM16
 - 1-port OC48c/STM16c
 - 4-port OC3c/STM1c
 - 4-port OC12c/STM4c
- Power requirement:
 - 1-port: 0.20 A @ 48 V (9.5 W)
 - 4-port: 0.40 A @ 48 V (19 W)
- Model number for 1-Port SONET/SDH OC12/STM4 (Multi-Rate) PIC: PB-IOC12-SON-SFP
Model number for 4-Port SONET/SDH OC12/STM4 (Multi-Rate) PIC: PB-IOC12-SON-SFP

Hardware features

- Multiplexing and demultiplexing
- Rate policing on input
- Rate shaping on output
- Packet buffering, Layer 2 parsing

Software features

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

Cables and connectors

You can install any transceiver supported by the PIC.

- Duplex LC/PC connector (Rx and Tx)
- SONET/SDH OC3/STM1 small form-factor pluggable (SFP) transceivers:
 - Multimode (model number: SFP-OC3-SR)
 - Intermediate reach (IR-1) (model number: SFP-OC3-IR)
 - Long reach (LR-1) (model number: SFP-OC3-LR)

Optical interface specifications—see [“SONET/SDH OC3/STM1 Optical Interface Specifications” on page 46](#)

- SONET/SDH OC12/STM4 small form-factor pluggable (SFP) transceivers:
 - Short reach (model number: SFP-OC12-SR)
 - Intermediate reach (IR-1) (model number: SFP-OC312-IR)
 - Long reach (LR-1) (model number: SFP-OC12-LR)

Optical interface specifications—see [“SONET/SDH OC12/STM4 Optical Interface Specifications” on page 48](#)

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 [CLI Explorer](#).

LEDs

One tricolor per port:

- Off—Not enabled
- Green—Online with no alarms or failures
- Yellow—Online with alarms for remote failures
- Red—Active with a local alarm; router has detected a failure

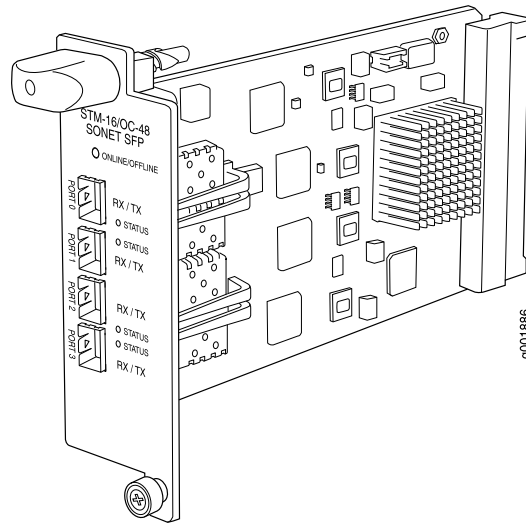
Alarms, errors, and events

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

Related Documentation

- *T640 PIC Description*
- *T640 PIC Combination Limitations*
- [T640 PICs Supported on page 3](#)

SONET/SDH OC48c/STM16 PIC with SFP (T640 Router)



Software release	Junos OS Release 6.2 and later For information on which FPCs support this PIC, see “T640 PIC/FPC Compatibility” on page 12.
Description	- Four OC48 ports - Power requirement: 0.46 A @ 48 V (22.1 W) - Model number: PC-4OC48-SON-SFP
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 (Junos OS Release 8.2 and later) - Configuration of SONET or SDH framing on a per-port basis (Junos OS Release 8.1 and later) - SONET/SDH framing - Link aggregation - Alarm and event counting and detection - Dual-router automatic protection switching (APS) - Multiprotocol Label Switching (MPLS) fast reroute - Encapsulations: - Circuit cross-connect (CCC) - Translational cross-connect (TCC) - Frame Relay - High-Level Data Link Control (HDLC) - Point-to-Point Protocol (PPP)

Cables and connectors	You can install any transceiver supported by the PIC. • Duplex LC/PC connector (Rx and Tx) • SONET/SDH OC48/STM16 fiber-optic SFP transceivers: • Short reach (SR-1) (model number: SFP-1OC48-SR) • Intermediate reach (IR-1) (model number: SFP-1OC48-IR) • Long reach (LR-1) (model number: SFP-1OC48-LR) Optical interface specifications—see “SONET/SDH OC48/STM16 Optical Interface Specifications” on page 51 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 CLI Explorer.
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

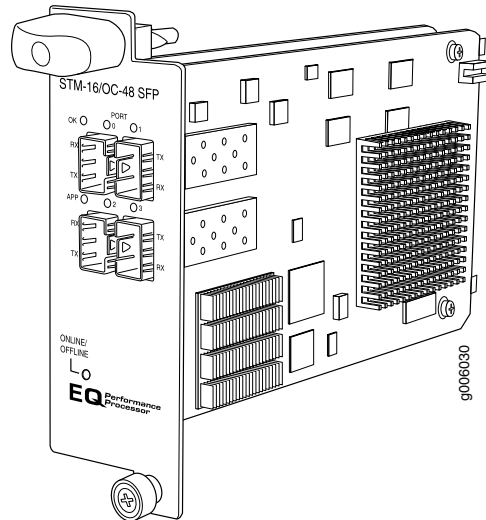
Alarms, errors, and events

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

Related Documentation

- *T640 PIC Description*
- *T640 PIC Combination Limitations*
- [T640 PICs Supported on page 3](#)

SONET/SDH OC48/STM16 Enhanced IQ (IQE) PIC with SFP (T640 Router)



Software release	Junos OS Release 10.4R2 and later (Type 3) For information on which FPCs support this PIC, see "T640 PIC/FPC Compatibility" on page 12.
Description	- Four OC48/STM16 ports - Clear channel functionality - SONET and SDH is configured on a per-port granularity - Power requirement: 1.06 A @ 48 V (51 W) - Weight: 1.6 lb (0.725 kg) - Model number: PC-4OC48-STM16-IQE-SFP
Hardware features	- Ports are numbered: - Top row: 0 and 1 from left to right - Bottom row: 2 and 3 from left to right - Maximum transmission units (MTUs) of up to 9192 bytes

Software features

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

Cables and connectors

You can install any transceiver supported by the PIC.

- Duplex LC/PC connector (Rx and Tx)
- SONET/SDH OC48/STM16 small form-factor pluggable (SFP) transceivers:
 - Short reach (SR-1) (model number: SFP-IOC48-SR)
 - Intermediate reach (IR-1) (model number: SFP-IOC48-IR)
 - Long reach (LR-1) (model number: SFP-IOC48-LR)

Optical interface specifications—see [“SONET/SDH OC48/STM16 Optical Interface Specifications” on page 51](#)

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

OK LED, one tricolor:

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

APP LED, one green per port:

- Off—Service is not running
- Green—Service is running under acceptable load

Port LEDs, one tricolor per port:

- Off—Not enabled
- Green—Online with no alarms or failures
- Yellow—Online with alarms for remote failures
- Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events**SONET alarms:**

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

SDH alarms:

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

Optical diagnostics related alarms:

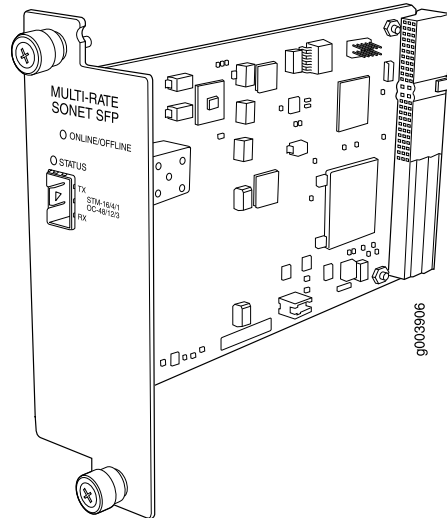
NOTE: Transceivers from some vendors do not support these fields.

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

Related Documentation

- *T640 PIC Description*
- *T640 PIC Combination Limitations*
- [T640 PICs Supported on page 3](#)

SONET/SDH OC48/STM16 (Multi-Rate) PIC with SFP (T640 Router)



Software release	Junos OS Release 8.3 and later (Type 2) For information on which FPCs support these PICs, see “T640 PIC/FPC Compatibility” on page 12.
Description	- Rate-selectable using one of the following rates: 1-port OC3c/STM1c 1-port OC12/STM4 1-port OC12c/STM4c 1-port OC48/STM16 1-port OC48c/STM16c - Power requirement: 0.20 A @ 48 V (9.5 W) - Model number: PB-1OC48-SON-B-SFP
Hardware features	- Multiplexing and demultiplexing - Rate policing on input - Rate shaping on output - Packet buffering, Layer 2 parsing
Software features	- Optical diagnostics and related alarms - Per-port SONET/SDH framing - Link aggregation - Alarm and event counting and detection - Multiprotocol Label Switching (MPLS) fast reroute - Encapsulations: - Circuit cross-connect (CCC) - Translational cross-connect (TCC) - Frame Relay - High-Level Data Link Control (HDLC) - Point-to-Point Protocol (PPP)

Cables and connectors	You can install any transceiver supported by the PIC. • Duplex LC/PC connector (Rx and Tx) • SONET/SDH OC3/STM1 small form-factor pluggable (SFP) transceivers: • Multimode (model number: SFP-OC3-SR) • Intermediate reach (IR-1) (model number: SFP-OC3-IR) • Long reach (LR-1) (model number: SFP-OC3-LR) Optical interface specifications—see “SONET/SDH OC3/STM1 Optical Interface Specifications” on page 46 • SONET/SDH OC12/STM4 small form-factor pluggable (SFP) transceivers: • Short reach (model number: SFP-OC12-SR) • Intermediate reach (IR-1) (model number: SFP-OC312-IR) • Long reach (LR-1) (model number: SFP-OC12-LR) Optical interface specifications—see “SONET/SDH OC12/STM4 Optical Interface Specifications” on page 48 • SONET/SDH OC48/STM16 small form-factor pluggable (SFP) transceivers: • Short reach (SR-1) (model number: SFP-IOC48-SR) • Intermediate reach (IR-1) (model number: SFP-IOC48-IR) • Long reach (LR-1) (model number: SFP-IOC48-LR) Optical interface specifications—see “SONET/SDH OC48/STM16 Optical Interface Specifications” on page 51 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 CLI Explorer.
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

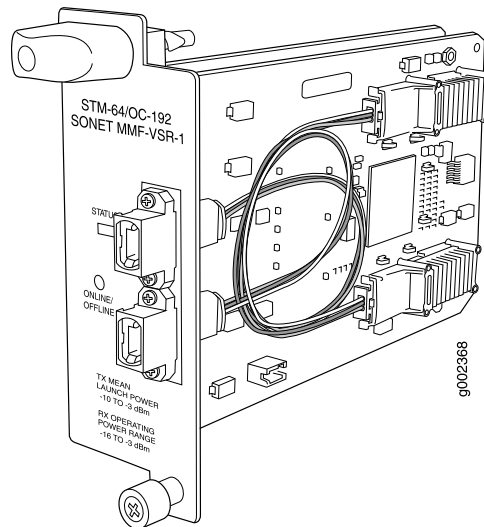
Alarms, errors, and events

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

Related Documentation

- *T640 PIC Description*
- *T640 PIC Combination Limitations*
- [T640 PICs Supported on page 3](#)

SONET/SDH OC192c/STM64 PIC (T640 Router)



Software release	Junos OS Release 5.3 and later (Type 3) For information on which FPCs support this PIC, see “T640 PIC/FPC Compatibility” on page 12.
Description	- One OC192 port - Power requirement: 0.45 A @ 48 V (21.6 W) - Model number: PC-1OC192-SON-VSR
Hardware features	- Multiplexing and demultiplexing - Rate policing on input - Rate shaping on output - Packet buffering, Layer 2 parsing
Software features	- SONET/SDH framing - Link aggregation - Alarm and event counting and detection - Dual-router automatic protection switching (APS) - Multiprotocol Label Switching (MPLS) fast reroute - Encapsulations: - Circuit cross-connect (CCC) - Translational cross-connect (TCC) - Frame Relay - High-Level Data Link Control (HDLC) - Point-to-Point Protocol (PPP)

Cables and connectors	• 12-ribbon multimode fiber with MTP connector (Rx and Tx) • SONET/SDH OC192/STM64 very short reach (VSR 1) transceiver Optical interface specifications—see “SONET/SDH OC192/STM64 Optical Interface Specifications” on page 53 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 CLI Explorer.
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events

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

Related Documentation

- *T640 PIC Description*
- *T640 PIC Combination Limitations*
- [T640 PICs Supported on page 3](#)

SONET/SDH OC192c/STM64 PICs with XFP (T640 Router)

Figure 25: 1-Port SONET/SDH OC192c/STM64 PIC

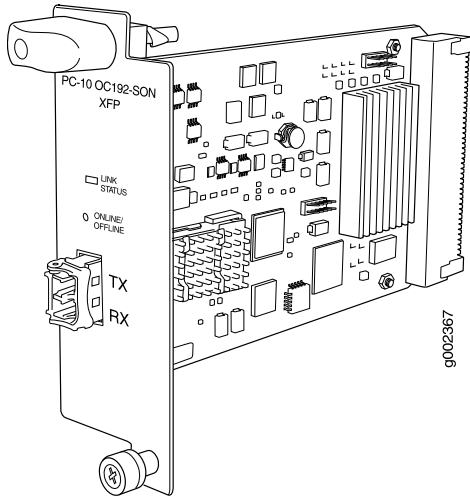
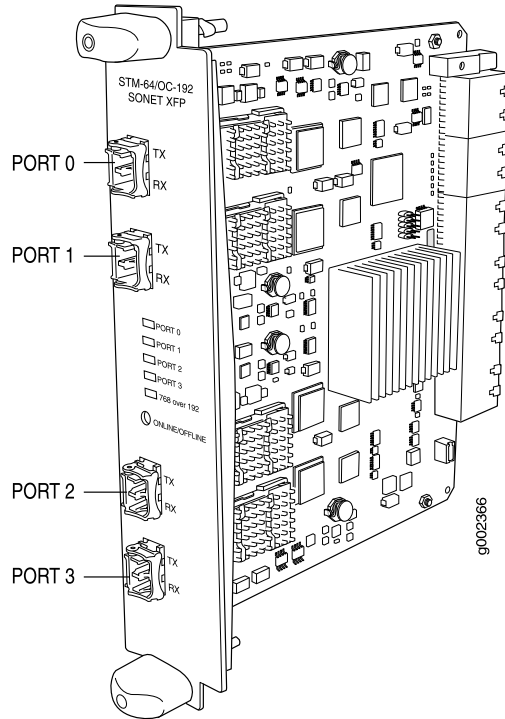


Figure 26: 4-Port SONET/SDH OC192c/STM64 PIC



Software release

- 1-port: Junos OS Release 8.1 and later (Type 3)
- 4-port: Junos OS Release 8.1 and later (Type 4)

For information on which FPCs support these PICs, see [“T640 PIC/FPC Compatibility” on page 12](#).

Description

- One or four OC192 ports
- 4-port OC192 PIC with XFP: four OC192 links can be aggregated into one OC768 link or two OC256 links. The four fiber links should be on the same fiber path or the same fiber.
- Power requirement:
 - 1-port: 0.52 A @ 48 V (25 W)
 - 4-port: 1.11 A @ 48 V (53.1 W)

Hardware features

- Multiplexing and demultiplexing
- Rate policing on input
- Rate shaping on output
- Packet buffering, Layer 2 parsing

Software features	• Configuration of SONET or SDH framing on a per-port basis on the 4-port Type 4 PIC (Junos OS Release 8.2 and later) • SONET/SDH framing • Link aggregation • Alarm and event counting and detection • Dual-router automatic protection switching (APS) • Multiprotocol Label Switching (MPLS) fast reroute • Encapsulations: • Circuit cross-connect (CCC) • Translational cross-connect (TCC) • Frame Relay • High-Level Data Link Control (HDLC) • Point-to-Point Protocol (PPP)
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Cables and connectors	• Duplex LC/PC connector (Rx and Tx) • SONET/SDH OC192c/STM64 XFP transceivers: • Short reach (SR-1) (model number: XFP-10G-L-OC192-SR1) • Intermediate reach (IR-1) (model number: XFP-10G-E-OC192-IR2) • Long reach (LR-1) (model number: XFP-10G-Z-OC192-LR2) Optical interface specifications—see “SONET/SDH OC192/STM64 Optical Interface Specifications” on page 53 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 CLI Explorer.
-----------------------	--

LEDs	One tricolor LED per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure One 768 over 192 LED: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure
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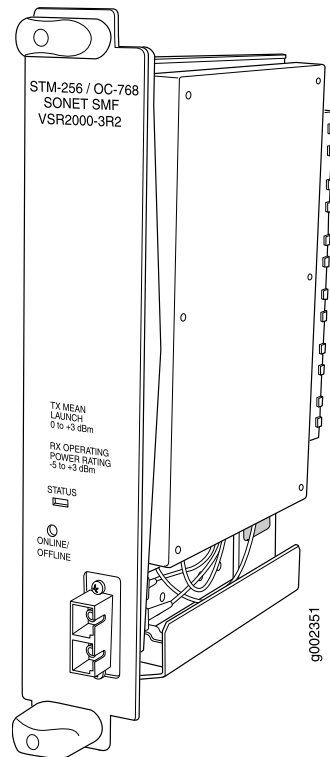
Alarms, errors, and events

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

**Related
Documentation**

- *T640 PIC Description*
- *T640 PIC Combination Limitations*
- [T640 PICs Supported on page 3](#)

SONET/SDH OC768c/STM256 PIC (T640 Router)



Software release	Junos OS Release 7.5 and later (Type 4) For information on which FPCs support this PIC, see “T640 PIC/FPC Compatibility” on page 12.
Description	- One OC768 port - Power requirement: 1.37 A @ 48 V (65.7 W) - Model number: PD-1OC768-SON-SR
Hardware features	- Multiplexing and demultiplexing - Rate policing on input - Rate shaping on output - Packet buffering, Layer 2 parsing

Software features	• SONET/SDH framing • Link aggregation • Alarm and event counting and detection • Dual-router automatic protection switching (APS) • Multiprotocol Label Switching (MPLS) fast reroute • Encapsulations: • Circuit cross-connect (CCC) • Translational cross-connect (TCC) • Frame Relay • High-Level Data Link Control (HDLC) • Point-to-Point Protocol (PPP) • Optical diagnostics and related alarms • Laser bias • Transmit optical power • Receiver optical power • Laser temperature
Cables and connectors	• Duplex SC/PC connector (Rx and Tx) • SONET/SDH OC768c/STM265 Short reach (SR-1) fixed transceiver Optical interface specifications—see “SONET/SDH OC768/STM256 Optical Interface Specifications” on page 57 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 CLI Explorer.
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events

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

Related Documentation

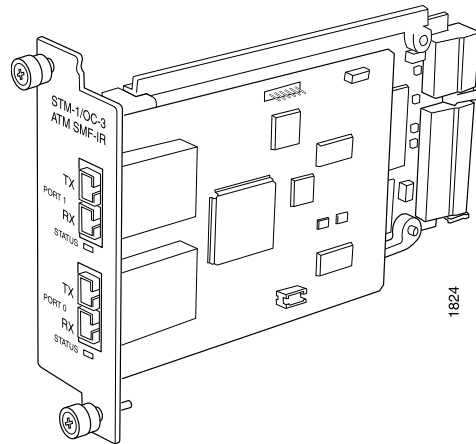
- *T640 PIC Description*
- *T640 PIC Combination Limitations*
- [T640 PICs Supported on page 3](#)

CHAPTER 15

End-of-Life PIC Descriptions

- [ATM OC3 EOL PIC \(T640 Router\) on page 186](#)
- [ATM OC12 EOL PIC \(T640 Router\) on page 187](#)
- [Channelized OC12 IQ EOL PIC \(T640 Router\) on page 189](#)
- [DS3 EOL PIC \(T640 Router\) on page 192](#)
- [Gigabit Ethernet EOL PICs \(T640 Router\) on page 193](#)
- [10-Gigabit Ethernet EOL PIC \(T640 Router\) on page 195](#)
- [Adaptive Services II EOL PIC \(T640 Router\) on page 196](#)
- [Adaptive Services II Layer 2 Services EOL PIC \(T640 Router\) on page 199](#)
- [Link Services EOL PIC \(T640 Router\) on page 201](#)
- [Monitoring Services II EOL PIC \(T640 Router\) on page 202](#)
- [Monitoring Services III EOL PIC \(T640 Router\) on page 204](#)
- [SONET/SDH OC3c/STM1 EOL PICs \(T640 Router\) on page 205](#)
- [SONET/SDH OC12c/STM4 EOL PICs \(T640 Router\) on page 208](#)
- [SONET/SDH OC48c/STM16 EOL PICs \(T640 Router\) on page 211](#)
- [SONET/SDH OC48c/STM16 EOL PIC with SFP \(T640 Router\) on page 214](#)
- [SONET/SDH OC192c/STM64 EOL PICs \(T640 Router\) on page 217](#)

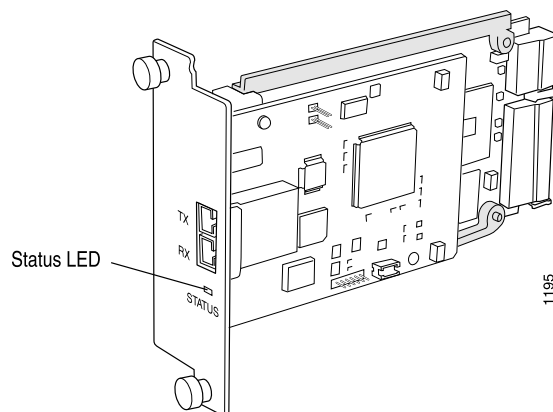
ATM OC3 EOL PIC (T640 Router)



Software release	Junos OS Release 4.0 and later
Description	- Two OC3 ports - Power requirement: 0.49 A @ 48 V (23.7 W) - 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	- Dual 3010 SAR for segmentation and reassembly into 53-byte ATM cells - High-performance parsing of SONET/SDH frames - OAM fault management processes alarm indication signal (AIS) and remote defect indicator (RDI) cells - ASIC-based packet segmentation and reassembly (SAR) management and output port queuing 16-MB SDRAM memory for ATM SAR - Packet buffering, Layer 2 parsing
Software features	- Multiprotocol Label Switching (MPLS) circuit cross-connect (CCC) for leveraging ATM access networks - Support for user-configurable virtual circuits (VC) and virtual paths (VP) - 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) - Unspecified bit rate (UBR) traffic shaping - Fine-grained variable bit rate (VBR) traffic shaping - Outbound PIC queues cells on a per-VC basis - Encapsulations—AAL5 subnetwork attachment point (SNAP)

Cables and connectors	- Duplex SC/PC connector (RX and TX) - SONET/SDH OC3 fixed transceivers: - Multimode - Single-mode intermediate reach (IR-1) Optical interface specifications—see “SONET/SDH OC3/STM1 Optical Interface Specifications” on page 46
LEDs	One tricolor per port: - Off—Not enabled - Green—Online with no alarms or failures - Yellow—Online with alarms for remote failures - Red—Active with a local alarm; router has detected a failure
Alarms, errors, and events	- Alarm indication signal (AIS-L, AIS-P) - Bit error rate signal degrade (BERR-SD), bit error rate signal fail (BERR-SF) - Bit interleaved parity errors B1, B2, B3 - Errored seconds (ES-S, ES-L, ES-P), far-end bit errors REI-L, REI-P (CV-LFE, CV-PFE), far-end 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)
Related Documentation	T640 PIC Description T640 End-of-Life PICs Supported on page 10 SONET/SDH OC3/STM1 Optical Interface Specifications on page 46

ATM OC12 EOL PIC (T640 Router)



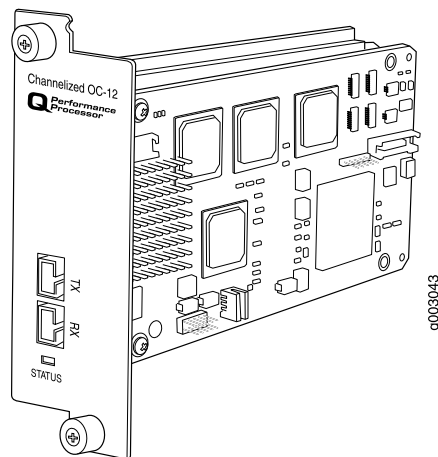
Software release	Junos OS Release 4.0 and later
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Description	• One OC12 port • Power requirement: 0.43 A @ 48 V (20.8 W) • Conforms to ANSI T1.105-1991 and T1E1.2/93-020R1 • ATM and SONET/SDH standards compliant • Alarm and event counting and detection • 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	• High-performance parsing of SONET/SDH frames • OAM fault management processes Alarm indication signal (AIS) and remote defect indicator (RDI) cells • ASIC-based packet segmentation and reassembly (SAR) management and output port queuing • 16-MB SDRAM memory for ATM SAR • Packet buffering, Layer 2 parsing
Software features	• Multiprotocol Label Switching (MPLS) circuit cross-connect (CCC) for leveraging ATM access networks • Support for user-configurable virtual circuits (VC) and virtual paths (VP) • 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) • Unspecified bit rate (UBR) traffic shaping • Fine-grained variable bit rate (VBR) traffic shaping • Outbound PIC queues cells on a per-VC basis • Encapsulations—AAL5 subnetwork attachment point (SNAP)
Cables and connectors	• Duplex SC/PC connector (RX and TX) • SONET/SDH OC12 fixed transceivers: • Multimode • Single-mode intermediate reach (IR-1) Optical interface specifications—see “SONET/SDH OC12/STM4 Optical Interface Specifications” on page 48
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events	- Alarm indication signal (AIS-L, AIS-P) - Bit error rate signal degrade (BERR-SD), bit error rate signal fail (BERR-SF) - Bit interleaved parity errors B1, B2, B3 - Errored seconds (ES-S, ES-L, ES-P), far-end bit errors REI-L, REI-P (CV-LFE, CV-PFE), far-end 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)
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Related Documentation	T640 PIC Description T640 End-of-Life PICs Supported on page 10
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Channelized OC12 IQ EOL PIC (T640 Router)



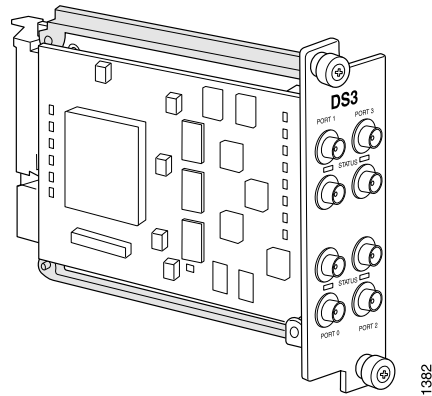
Software release	Junos OS Release 6.3 and later (Type 1)
Description	- One OC12 port - Power requirement: 0.23 A @ 48 V (10.8 W) - Fine-grained queuing per logical interface - Channelization: OC3, DS3, DS1, DS0

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: • Circuit cross-connect (CCC) • Translational cross-connect (TCC) • Frame Relay • High-Level Data Link Control (HDLC) • Point-to-Point Protocol (PPP)
Cables and connectors	• Duplex SC/PC connector (Rx and Tx); single-mode fiber • SONET/SDH OC12 single-mode intermediate reach (IR-1) fixed transceiver • Optical interface specifications—see “SONET/SDH OC12/STM4 Optical Interface Specifications” on page 48
LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure

Alarms, errors, and events	Alarms: • Alarm indication signal—line (AIS-L) • Alarm indication signal—path (AIS-P) • Bit error rate—signal degrade (BERR-SD) • Bit error rate—signal fail (BERR-SF) • 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 (unequipped STS at path level) (UNEQ-P) • Parity bit (P-bit) disagreements • Path parity error • Remote defect indication—line (RDI-L) • Remote defect indication—path (RDI-P) • Yellow alarm bit (X-bit) disagreements Error detection: • 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, remote error indication—line (REI-L), far-end line coding violations (CV-LFE) • Far-end bit errors, remote error indication—path (REI-P), far-end path coding violations (CV-PFE) • Far-end errored seconds (ES-LFE, ES-PFE) • Far-end severely errored seconds (SES-LFE, SES-PFE) • Far-end unavailable seconds (UAS-LFE, UAS-PFE) • Severely errored framing (SEF) • Severely errored framing seconds (SEFS-S) • Severely errored seconds (SES-S, SES-L, SES-P) • Unavailable seconds (UAS-L, UAS-P)
Instrumentation (counters)	• Layer 2 per-queue and per-channel packet and byte counters

- Related Documentation**
- *T640 PIC Description*
 - [T640 End-of-Life PICs Supported on page 10](#)

DS3 EOL PIC (T640 Router)



Software release	- Junos OS Release 6.3 and later (Type 1) - Junos OS Release 7.0 and later in T640 routers connected to a TX Matrix platform
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 - Yellow—Online with alarms for remote failures - Red—Active with a local alarm; router has detected a failure
Alarms, errors, and events	- Alarm indication signal (AIS) - 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

- Related Documentation**
- [T640 PIC Description](#)
 - [T640 End-of-Life PICs Supported on page 10](#)

Gigabit Ethernet EOL PICs (T640 Router)

Figure 27: 2-Port Gigabit Ethernet PIC

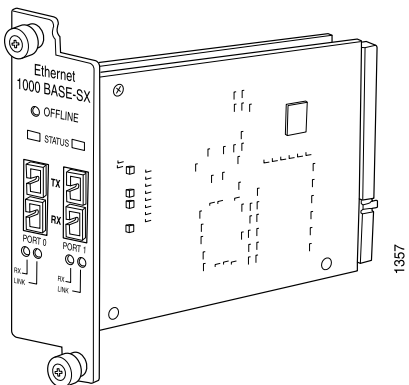
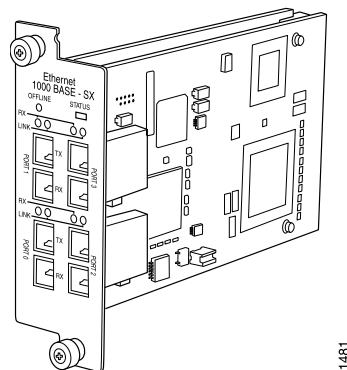


Figure 28: 4-Port Gigabit Ethernet PIC

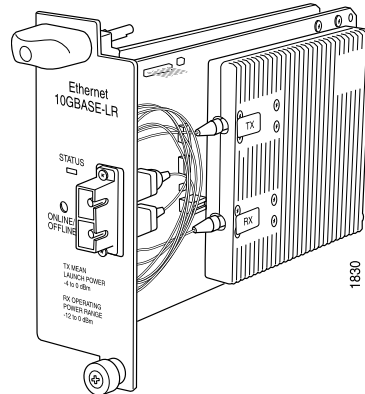


- Software release**
- 2-port and 4-port: Junos OS Release 5.3 and later

Description	- Two or four Gigabit Ethernet ports - Power requirements: 2-port: 0.35 A @ 48 V (17 W) 4-port: 0.40 A @ 48 V (19.2 W) - Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network
Hardware features	- High-performance throughput on all ports at speeds up to 1 Gbps - Autonegotiation between Gigabit Ethernet circuit partners - Full-duplex mode - Maximum transmission units (MTUs) of up to 9192 bytes Note: If you use a 4-port Gigabit Ethernet PIC on a Juniper Networks M160 router, the MTU will decrease to 4500 bytes.
Software features	- Virtual Router Redundancy Protocol (VRRP) support 802.1Q virtual LANs (VLANs) support 64 source MAC address filters per port 960 destination MAC filters per port
Cables and connectors	- Duplex SC/PC connector (TX and RX) 10-Gigabit Ethernet Fiber-optic fixed transceivers: 2-port: 1000Base-LX 2-port and 4-port: 1000Base-SX Optical interface specifications—see "Gigabit Ethernet 1000BASE Optical Interface Specifications" on page 32
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

- Related Documentation**
- [T640 PIC Description](#)
 - [T640 End-of-Life PICs Supported on page 10](#)

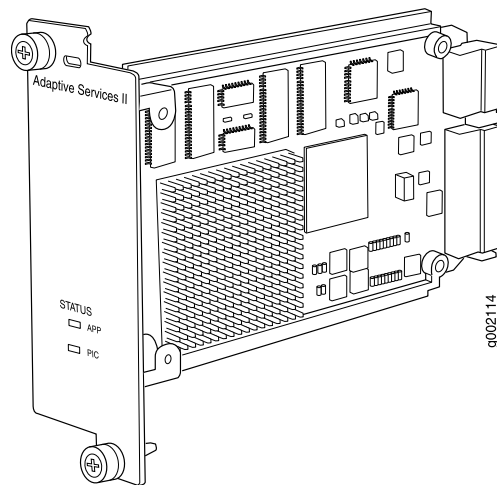
10-Gigabit Ethernet EOL PIC (T640 Router)



Software release	- Junos OS Release 5.4 and later - Junos OS Release 9.0 and later supports the 10-Gigabit Ethernet PIC on the T640 Enhanced Scaling FPC3 (T640-FPC3-ES).
Description	- One 10-Gigabit Ethernet port - Power requirement: 0.74 A @ 48 V (35.5 W) - Supports large Ethernet frame sizes for more efficient throughput across the intra-POP network
Hardware features	- High-performance throughput at speeds up to 10 Gbps - Full-duplex mode - Maximum transmission units (MTUs) up to 9192 bytes 64 source MAC address filters 960 destination MAC filters
Software features	- Virtual Router Redundancy Protocol (VRRP) support 802.1Q virtual LANs (VLANs) support 802.3ae link aggregation support - RMON EtherStats
Cables and connectors	- Duplex SC/PC connector (RX and TX) 10-Gigabit Ethernet 10GBASE-LR fixed transceiver - Optical interface specifications—see "10-Gigabit Ethernet 10GBASE Optical Interface Specifications" on page 36
LEDs	Status LED, one bicolor: - Off—PIC not enabled - Green—PIC is operating normally - Red—PIC has an error or failure Port LEDs, one pair: - Link—If green, the port is online; if there is no light, the port is down - RX—If flashing green, the port is receiving data; if there is no light, the port might be on, but is not receiving data

- Related Documentation**
- [T640 PIC Description](#)
 - [T640 End-of-Life PICs Supported on page 10](#)

Adaptive Services II EOL PIC (T640 Router)



Software release	• Junos OS Release 6.4 and later (Type 1) • Junos OS Release 7.3 and later in T640 routers connected to a TX Matrix platform • Junos OS Release 9.4 and later supports the PB-AS2 PIC on the T640 Enhanced Scaling FPC1 (T640-FPC1-ES).
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 OS Release and individual licenses, software features for this PIC can include the features listed in Table 52 on page 197. For more information about the software features available for services PICs, see the <i>Junos OS Services Interfaces Library for Routing Devices</i>.

LEDs

Status LED, one tricolor:

- Off—PIC is offline and it is safe to remove it from the chassis.
- Green—PIC is operating normally.
- Yellow—PIC is initializing.
- Red—PIC has an error or failure and no further harm can be done by removing it from the chassis.

Application LED, one bicolor:

- Off—Service is not running.
- Green—Service is running under acceptable load.
- Yellow—Service is overloaded.

Table 52: Adaptive Services PICs Software Features

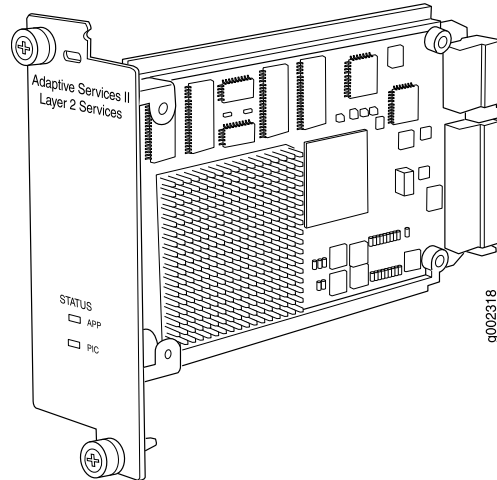
Software Feature	Adaptive Services II PIC	Adaptive Services II Layer 2 Services PIC
GRE Key	—	—
GRE dont-fragment	—	—
Stateful firewall with packet inspection: detects SYN attacks, ICMP and UDP floods, and ping-of-death attacks	6.4	—
Network Address Translation (NAT) for IP addresses	6.4	—
Port Address 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

Table 52: Adaptive Services PICs Software Features (*continued*)

Software Feature	Adaptive Services II PIC	Adaptive Services II Layer 2 Services PIC
Tunnel services:	6.4	7.5
• IP-IP unicast tunneling • GRE unicast tunneling—Supports GRE fragmentation • Protocol Independent Multicast (PIM) sparse mode unicast tunneling		
Virtual tunnel interface for Layer 3 VPNs	6.4	—
Layer 2 Tunneling Protocol (L2TP)	—	—
Voice services:	7.3	7.5
• Compressed Real-Time Transport Protocol (CRTP)		
Encapsulations:	7.1	7.5
• Multilink Frame Relay (MLFR) • Multilink Point-to-Point Protocol (MLPP)		

- Related Documentation**
- [T640 PIC Description](#)
 - [T640 End-of-Life PICs Supported on page 10](#)

Adaptive Services II Layer 2 Services EOL PIC (T640 Router)



Software release	Junos OS Release 7.5 and later (Type 1) NOTE: The Adaptive Services II Layer 2 Services PIC is not supported by T640 routers connected to a TX Matrix platform.
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 OS Release and individual licenses, software features for this PIC can include the features listed in Table 53 on page 199 . For more information about the software features available for services PICs, see the <i>Junos OS Services Interfaces Library for Routing Devices</i> .
LEDs	Status LED, one tricolor: - Off—PIC is offline and it is safe to remove it from the chassis. - Green—PIC is operating normally. - Yellow—PIC is initializing. - Red—PIC has an error or failure and no further harm can be done by removing it from the chassis. Application LED, one bicolor: - Off—Service is not running. - Green—Service is running under acceptable load. - Yellow—Service is overloaded.

Table 53: Adaptive Services PICs Software Features

Software Feature	Adaptive Services II PIC	Adaptive Services II Layer 2 Services PIC

Table 53: Adaptive Services PICs Software Features (*continued*)

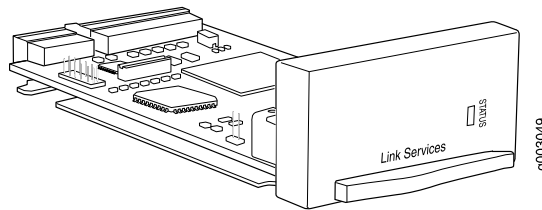
Software Feature	Adaptive Services II PIC	Adaptive Services II Layer 2 Services PIC
GRE Key	—	—
GRE dont-fragment	—	—
Stateful firewall with packet inspection: detects SYN attacks, ICMP and UDP floods, and ping-of-death attacks	6.4	—
Network Address Translation (NAT) for IP addresses	6.4	—
Port Address 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)	—	—

Table 53: Adaptive Services PICs Software Features (*continued*)

Voice services:	7.3	7.5
Compressed Real-Time Transport Protocol (CRTP)		
Encapsulations:	7.1	7.5
- Multilink Frame Relay (MLFR) - Multilink Point-to-Point Protocol (MLPP)		

- Related Documentation**
- [T640 PIC Description](#)
 - [T640 End-of-Life PICs Supported on page 10](#)

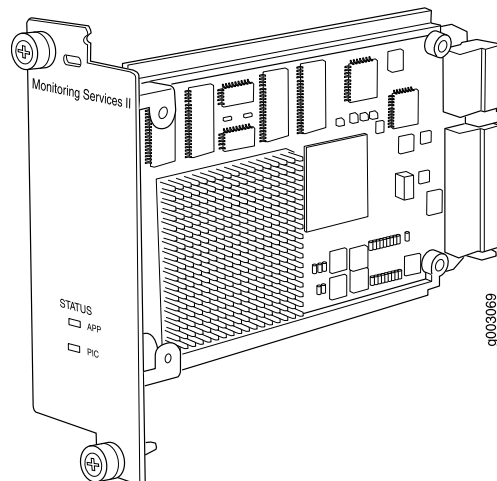
Link Services EOL PIC (T640 Router)



Software release	Junos OS Release 6.0 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 <i>Junos OS Services Interfaces Library for Routing Devices</i>. - 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 - Yellow—PIC is online, but no configured bundles are operating
Related Documentation	T640 PIC Description T640 End-of-Life PICs Supported on page 10

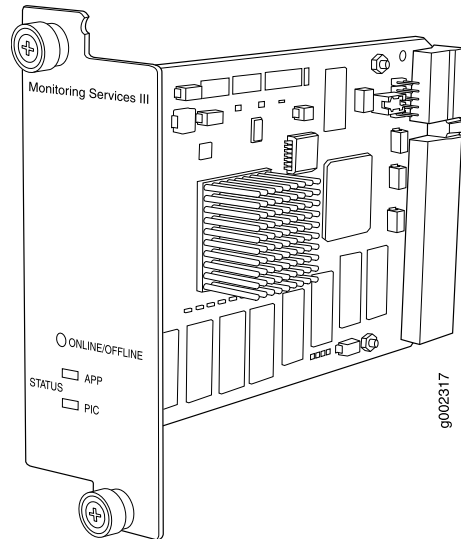
Monitoring Services II EOL PIC (T640 Router)



Software release	Junos OS Release 7.1R2 and later (Type 1) For information on which FPCs support this PIC, see "T640 PIC/FPC Compatibility" on page 12.
Description	- Passive traffic monitoring or flow collection services - Power requirement: 0.4 A @ 48 V (19 W) - Monitors IPv4 packets - Support for collecting and exporting cflowd records

Hardware features	- Monitors up to 400,000 packets per second - Support for MTUs up to 4474 bytes for SONET interfaces
Software features	For more information about the software features for services PICs, see the <i>Junos OS Services Interfaces Library for Routing Devices</i>. - Load distribution across multiple PICs - Active monitoring cflowd version 5 support - Provides start and end times of each export - Encapsulations: - Multilink Frame Relay (MLFR) - Multilink Point-to-Point Protocol (MLPP) - Supports firewall filtering and filter-based forwarding (FBF) NOTE: Flow collection services are supported. NOTE: This PIC does not support graceful Routing Engine switchover.
Cables and connectors	None
LEDs	Status LED, one tricolor: - Off—PIC is offline and it is safe to remove it from the chassis. - Green—PIC is operating normally. - Yellow—PIC is initializing. - Red—PIC has an error or failure and no further harm can be done by removing it from the chassis. Application LED, one bicolor: - Off—Flow collector is not running. - Green—Flow collector is running under acceptable load. - Yellow—Flow collector is overloaded.
Related Documentation	T640 PIC Description T640 PIC Combination Limitations T640 PICs Supported on page 3

Monitoring Services III EOL PIC (T640 Router)



Software release

- Junos OS Release 7.4 and later (Type 2)
- For information on which FPCs support this PIC, see ["T640 PIC/FPC Compatibility"](#) on page 12.

NOTE: The Monitoring Services III PIC is not supported by T640 routers connected to a TX Matrix router.

Description

- Power requirement: 0.4 A @ 48 V (19 W)
- Supports dynamic flow capture
- 2 Gbps of sustained packet bandwidth

Hardware features

- Supports MTUs up to 4474 bytes for SONET interfaces

Software features

For more information about the software features for services PICs, see the *Junos OS Services Interfaces Library for Routing Devices*.

- Dynamic flow capture

Cables and connectors

- None

LEDs

Two Status LEDs: PIC and APP

PIC LED, one tricolor:

- Off—PIC is offline and it is safe to remove it from the chassis.
- Green—PIC is operating normally.
- Yellow—PIC is initializing.
- Red—PIC has an error or failure and no further harm can be done by removing it from the chassis.

Application LED, one tricolor:

- Off—Monitoring application is not running.
- Green—Monitoring application is running under acceptable load.
- Yellow—Monitoring application is overloaded.
- Red—Not used.

Related Documentation

- [T640 PIC Description](#)
- [T640 PIC Combination Limitations](#)
- [T640 PICs Supported on page 3](#)

SONET/SDH OC3c/STM1 EOL PICs (T640 Router)

Figure 29: SONET/SDH OC3c/STM1 PIC (MMF)

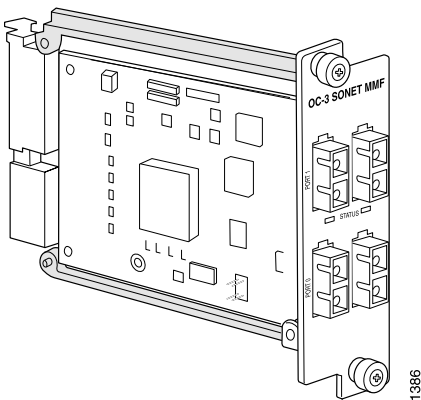
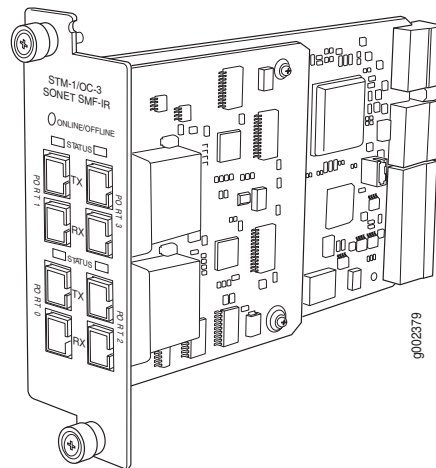


Figure 30: SONET/SDH OC3c/STM1 PIC (SMF-IR)



Software release

- Junos OS Release 5.5 and later (Type 2) multimode and single-mode intermediate reach
- Junos OS Release 7.1 and later (Type 1) multimode and single-mode intermediate reach
- Junos OS Release 9.4 and later supports the PB-40C3-MM and PB-40C3-SMIR PICs on the T640 Enhanced Scaling FPC1 (T640-FPC1-ES).

Description

- Four OC3 ports
- Power requirement: 0.49 A @ 48 V @ 23.7 W)

- | | |
|-------------------|---|
| Hardware features | <ul style="list-style-type: none">• Multiplexing and demultiplexing• Rate policing on input• Rate shaping on output• Packet buffering, Layer 2 parsing |
|-------------------|---|

- | | |
|-------------------|---|
| Software features | <ul style="list-style-type: none">• SONET/SDH framing• Link aggregation• Alarm and event counting and detection• Dual-router automatic protection switching (APS)• Multiprotocol Label Switching (MPLS) fast reroute• Encapsulations:<ul style="list-style-type: none">• High-Level Data Link Control (HDLC)• Frame Relay• Circuit cross-connect (CCC)• Translational cross-connect (TCC)• Point-to-Point Protocol (PPP) |
|-------------------|---|

- | | |
|-----------------------|---|
| Cables and connectors | <ul style="list-style-type: none">• Duplex SC/PC connector (Rx and Tx)• SONET/SDH OC3/STM1 fixed transceivers:<ul style="list-style-type: none">• Multimode• Single-mode intermediate reach (IR-1) <p>Optical interface specifications—see “SONET/SDH OC3/STM1 Optical Interface Specifications” on page 46</p> |
|-----------------------|---|

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 [CLI Explorer](#).

- | | |
|------|--|
| LEDs | <p>One tricolor per port:</p> <ul style="list-style-type: none">• Off—Not enabled• Green—Online with no alarms or failures• Yellow—Online with alarms for remote failures• Red—Active with a local alarm; router has detected a failure |
|------|--|

-
- Alarms, errors, and events
- SONET alarms:
 - Alarm indication signal—line (AIS-L)
 - Alarm indication signal—path (AIS-P)
 - Bit error rate signal degrade (BERR-SD)
 - Bit error rate signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1
 - 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)
-

- Related Documentation**
- [T640 PIC Description](#)
 - [T640 End-of-Life PICs Supported on page 10](#)

SONET/SDH OC12c/STM4 EOL PICs (T640 Router)

Figure 31: 1-Port SONET/SDH OC12c/STM4 PIC

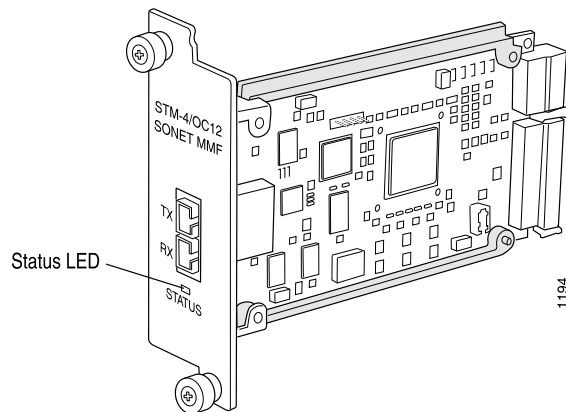
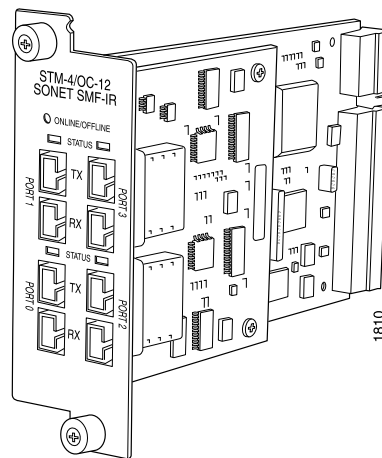


Figure 32: 4-Port SONET/SDH OC12c/STM4 PIC



Software release	- Junos OS Release 5.5 and later: 1-port single-mode (Type 1) - Junos OS Release 7.1 and later: 1-port multimode (Type 1) - Junos OS Release 5.3 and later: 4-port single-mode (Type 2) - Junos OS Release 9.4 and later supports the PB-1OC12-SON-MM PIC on the T640 Enhanced Scaling FPC1 (T640-FPC1-ES).
Description	- One or four ports - 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)
- SONET/SDH OC12/STM4 fixed transceivers:
 - 1-port and 4-port: Multimode
 - 4-port: Single-mode intermediate reach (IR-1)

Optical interface specifications—see [“SONET/SDH OC12/STM4 Optical Interface Specifications” on page 48](#)

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 [CLI Explorer](#).

LEDs

One tricolor per port:

- Off—Not enabled
- Green—Online with no alarms or failures
- Yellow—Online with alarms for remote failures
- Red—Active with a local alarm; router has detected a failure

- Alarms, errors, and events
- SONET alarms:
 - Alarm indication signal—line (AIS-L)
 - Alarm indication signal—path (AIS-P)
 - Bit error rate signal degrade (BERR-SD)
 - Bit error rate signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1
 - 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)
-

- Related Documentation**
- [T640 PIC Description](#)
 - [T640 End-of-Life PICs Supported on page 10](#)

SONET/SDH OC48c/STM16 EOL PICs (T640 Router)

Figure 33: 1-Port SONET/SDH OC48c/STM16 PIC

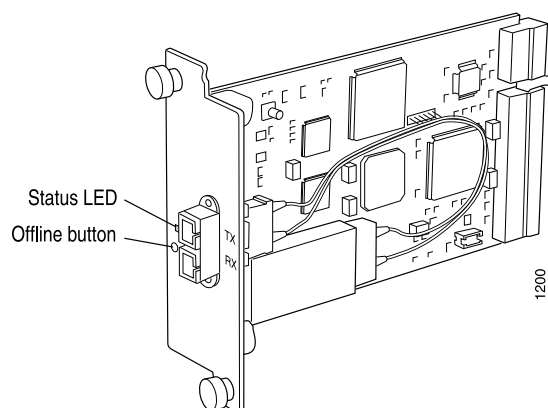
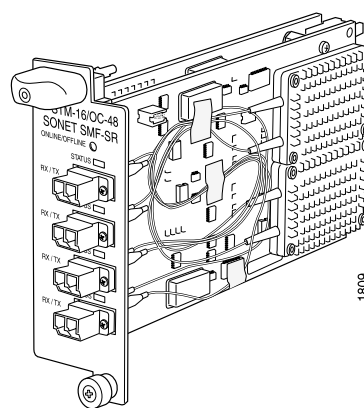


Figure 34: 4-Port SONET/SDH OC48c/STM16 PIC



Software release	1-port: Junos OS Release 5.3 and later (Type 2) (LR) 4-port: Junos OS Release 5.3 and later 4-port: Junos OS Release 9.0 and later supports the SONET/SDH OC48c/STM16 PIC on the T640 Enhanced Scaling FPC3 (T640-FPC3-ES).
Description	- One or four OC48 ports - Power requirements: 1-port: 0.38 A @ 48 V (8 W) 4-port: 0.86 A @ 48 V (41.4 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)
- SONET/SDH OC48/STM16 fixed transceivers:
 - 1-port and 4-port: Short reach (SR-1)
 - 1-port: Long reach (LR-1)
- Optical interface specifications—see [“SONET/SDH OC48/STM16 Optical Interface Specifications” on page 51](#)

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 [CLI Explorer](#).

LEDs

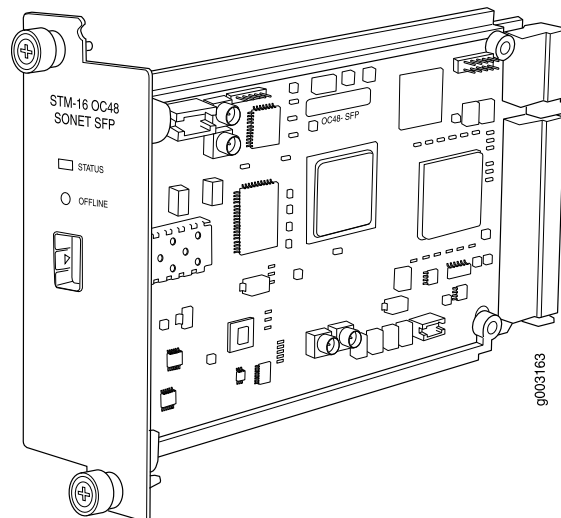
One tricolor per port:

- Off—Not enabled
- Green—Online with no alarms or failures
- Yellow—Online with alarms for remote failures
- Red—Active with a local alarm; router has detected a failure

-
- Alarms, errors, and events
- SONET alarms:
 - Alarm indication signal—line (AIS-L)
 - Alarm indication signal—path (AIS-P)
 - Bit error rate signal degrade (BERR-SD)
 - Bit error rate signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1
 - 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)
-

- Related Documentation**
- [T640 PIC Description](#)
 - [T640 End-of-Life PICs Supported on page 10](#)

SONET/SDH OC48c/STM16 EOL PIC with SFP (T640 Router)



Software release	Junos OS Release 6.1 and later
Description	- One OC48 port - Power requirement: 0.33 A @ 48 V (16 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 LC/PC Connector (Rx and Tx)
- SONET/SDH OC48/STM16 fiber-optic SFP transceivers:
 - Short reach (SR-1) (model number: SFP-IOC48-SR)
 - Intermediate reach (IR-1) (model number: SFP-IOC48-IR)
 - Long reach (LR-1) (model number: SFP-IOC48-LR)

Optical interface specifications—see ["SONET/SDH OC48/STM16 Optical Interface Specifications" on page 51](#)

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 [CLI Explorer](#).

LEDs

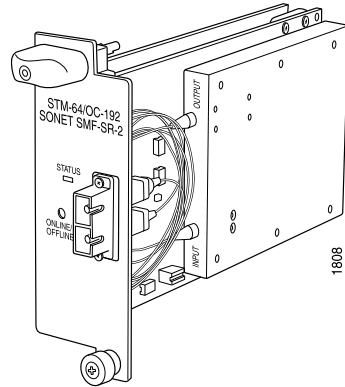
One tricolor per port:

- Off—Not enabled
- Green—Online with no alarms or failures
- Yellow—Online with alarms for remote failures
- Red—Active with a local alarm; router has detected a failure

- Alarms, errors, and events
- SONET alarms:
 - Alarm indication signal—line (AIS-L)
 - Alarm indication signal—path (AIS-P)
 - Bit error rate signal degrade (BERR-SD)
 - Bit error rate signal fail (BERR-SF)
 - Bit interleaved parity (BIP) error B1
 - 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)
-

- Related Documentation**
- [T640 PIC Description](#)
 - [T640 End-of-Life PICs Supported on page 10](#)

SONET/SDH OC192c/STM64 EOL PICs (T640 Router)



Software release	- Junos OS Release 5.4 and later (Type 3) - Junos OS Release 9.0 and later supports the SONET/SDH OC192c/STM64 PICs (PC-10C192-SON-SR2) and (PC-10C192-SON-LR) on the T640 Enhanced Scaling FPC3 (T640-FPC3-ES).
Description	- One OC192 port - Power requirement: 0.45 A @ 48 V (21.6 W)
Hardware features	- Multiplexing and demultiplexing - Rate policing on input - Rate shaping on output - Packet buffering, Layer 2 parsing
Software features	- SONET/SDH framing - Link aggregation - Alarm and event counting and detection - Dual-router automatic protection switching (APS) - Multiprotocol Label Switching (MPLS) fast reroute - Encapsulations: - High-Level Data Link Control (HDLC) - Frame Relay - Circuit cross-connect (CCC) - Translational cross-connect (TCC) - Point-to-Point Protocol (PPP)
Cables and connectors	SONET/SDH OC192/STM64 fixed transceivers: - Short reach (SR-2): duplex SC/PC connector (Rx and Tx) - Long reach (LR-1): duplex SC/PC connector (Rx and Tx) - Optical interface specifications—see “SONET/SDH OC192/STM64 Optical Interface Specifications” on page 53 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 CLI Explorer.

LEDs	One tricolor per port: • Off—Not enabled • Green—Online with no alarms or failures • Yellow—Online with alarms for remote failures • Red—Active with a local alarm; router has detected a failure
Alarms, errors, and events	• SONET alarms: • Alarm indication signal—line (AIS-L) • Alarm indication signal—path (AIS-P) • Bit error rate signal degrade (BERR-SD) • Bit error rate signal fail (BERR-SF) • Bit interleaved parity (BIP) error B1 • 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)

Related Documentation • *T640 PIC Description*

- [T640 End-of-Life PICs Supported on page 10](#)

